AVIATION WEEK

A McGRAW-HILL PUBLICATION

May 21, 1956 50 cents

Vertol's New Vertical Lift Plane for Army

Douglas C-133A

Navy's Newest Aircraft Are Tested at Patuxent

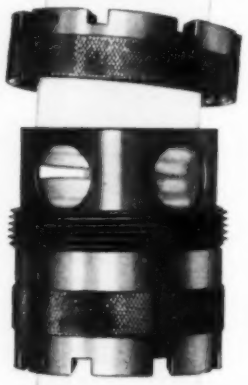
Gun Camera Exposure Selected Automatically

Are You Interested In WEIGHT REDUCTION?

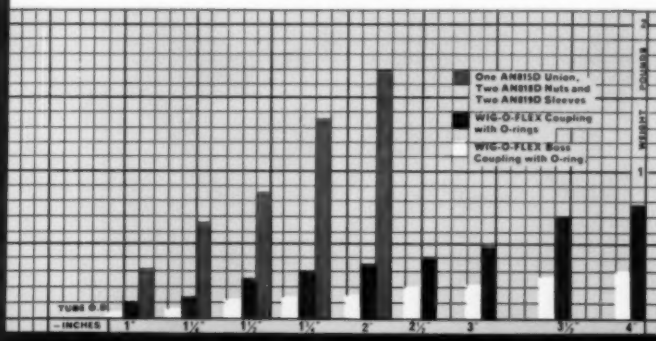
WIGGINS COUPLINGS SAVE 88 POUNDS ON LOCKHEED C-130

America's first turbo-prop transport—the Lockheed C-130—is 88 pounds lighter because WIG-O-FLEX Couplings replaced standard AN connections and cut hose. WIG-O-FLEX Couplings weigh 1/5 as much as the standard AN connections they can replace. (See Weight Chart for exact comparisons.)

WIG-O-FLEX® COUPLING



flexible union for connecting rigid tubes



WEIGHT COMPARISON CHART
WIG-O-FLEX COUPLING & AN STANDARD FLARED TUBE CONNECTION

MAIN HYDRAULIC SYSTEM FOR FUEL, OIL, AIR

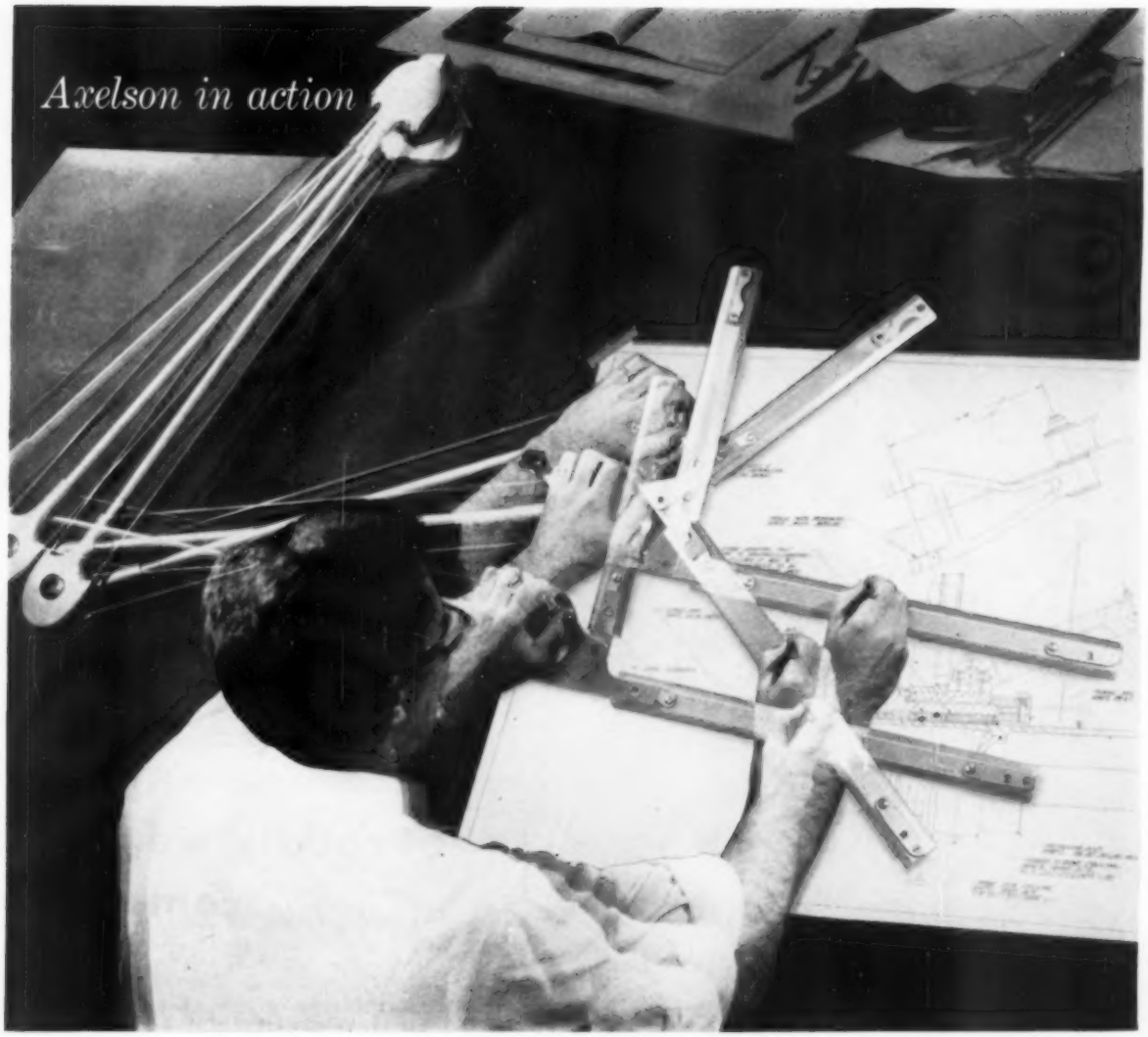
- Withstands more than 1000 psi burst pressure.
- Accommodates 4° tube flexure.
- Installs locally. 80% lighter.
- Temperature range −65°F to +250°F.

SIZES: 1", 1¼", 1½", 1¾", 2", 2½", 3", 3½", 4"

Wiggins

E. B. WIGGINS OIL TOOL COMPANY, INC.
3424 East Olympic Boulevard, Los Angeles 23, California

WRITE FOR FURTHER INFORMATION



$$f_b = \frac{(M_x' \cos\theta)\, Y}{I_x} - \frac{(M_y' \sin\theta)\, X}{I_y}$$

The dynamics of solving for f_b

A stress engineer on Axelson's design and development staff calculates the flexural stress on a landing gear that results from unsymmetrical bending . . . a symbol of painstaking investigation, characteristic of Axelson's expanding service to the aircraft industry.

Axelson has become the symbol of achievement in the production of aircraft components and subassemblies . . . landing gears, shock struts, spars, geared mechanisms and hydraulic units for such airplanes as the B-52, B-47, A3-D, A4-D, F4-D, B-57 and T-28.

Axelson . . . leaders for more than thirty years in production experience, craftsmanship, facilities . . . again moves ahead with augmented research and design personnel and facilities, providing the industry with a single source for complete programs.

Plan from the beginning with Axelson for the kind of components you want, when you want them.

Axelson Manufacturing Company

AXELSON AIRCRAFT

Division of U. S. Industries, Inc.

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World's Fastest Navy Fighter

9 Proudly wears Sargent controls

Nine Sargent quality units have been selected to provide Chance Vought's F8U-1 Crusader with instantaneous, positive, feathertouch response.

These units, Sargent fabricated to Vought specifications, provide a system for control for the safe, positive, efficient operation of this great fighter.

The experience of more than 36 years of design and manufacture of precision equipment systems has given Sargent Engineering Corporation the "know-how" to aid in solving the essential and advance problems of force control. Leading airframe and missile manufacturers are using hundreds of different Sargent hydraulic, mechanical, pneumatic, electrical and electronic force control units on the nation's military planes, commercial planes and missiles.

Sargent places its facilities of design and manufacture at your disposal. We invite you to send your specifications for the Sargent proposal of your force control problems.

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— U.S. Supreme Court

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BUILDS QUALITY THAT BUILDS GOOD WILL

AVIATION CALENDAR

May 24-26—Armed Forces Communications and Electronics Association, 10th national convention, Boston, Mass.

May 30-June 3—Eighth Annual Wright Memorial Glider Meet, sponsored by The Soaring Society of Dayton, Dayton.

June 2—Seventh Annual Maintenance & Operations Meeting, Reading Aviation Service, Inc., Reading Municipal Airport, Reading, Pa.

June 3-8—Society of Automotive Engineers, summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 4—National Fire Protection Association Seminar on Jet Speed with Fire Safety, Hotel Statler, Boston, Mass.

June 5-6—Spring Assembly Radio Technical Commission for Aeronautics, Hotel Statler, Boston.

June 11-15—Society of the Plastics Industry, Seventh National Plastics Exposition, New Coliseum, New York, N. Y.

June 13—B. F. Goodrich Technical Forum, co-sponsored by Atlantic Aviation Corp. and Airwork Corp., Atlantic Aviation Hangar, Teterboro Airport, Teterboro.

June 17—Second Annual Air Show, sponsored by Post 1920 Veterans of Foreign Wars and Burlington Flying Service, Inc., Municipal Airport, Burlington, N. C.

June 17-21—American Society of Mechanical Engineers, semi-annual meeting, Hotel Statler, Cleveland, Ohio.

June 17-30—Third Annual Material Handling Training Conference, Lake Placid, N. Y.

June 18-21—National summer meeting of the Institute of Aeronautical Sciences, IAS Bldg., 7660 Beverly Blvd., Los Angeles.

June 19—Council of the International Civil Aviation Organization, 10th session, Caracas, Venezuela.

June 20-22—Aviation Distributors and Manufacturers Assn., 27th meeting, Grove Park Inn., Asheville, N. C.

June 25-27—High Temperature, Symposium, Berkeley Campus, University of California.

June 30—Jet Age Conference, Sheraton-Jefferson Hotel, St. Louis, Mo.

July 8—Third annual Western New York Air Show and Races, Niagara Falls Municipal Airport, Niagara Falls, N. Y.

AVIATION WEEK • MAY 21, 1956

Vol. 64, No. 21

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GLA ignition

airplane | CONVAIR F-102A

engine | P & W A J-57

ignition | G. L. A.

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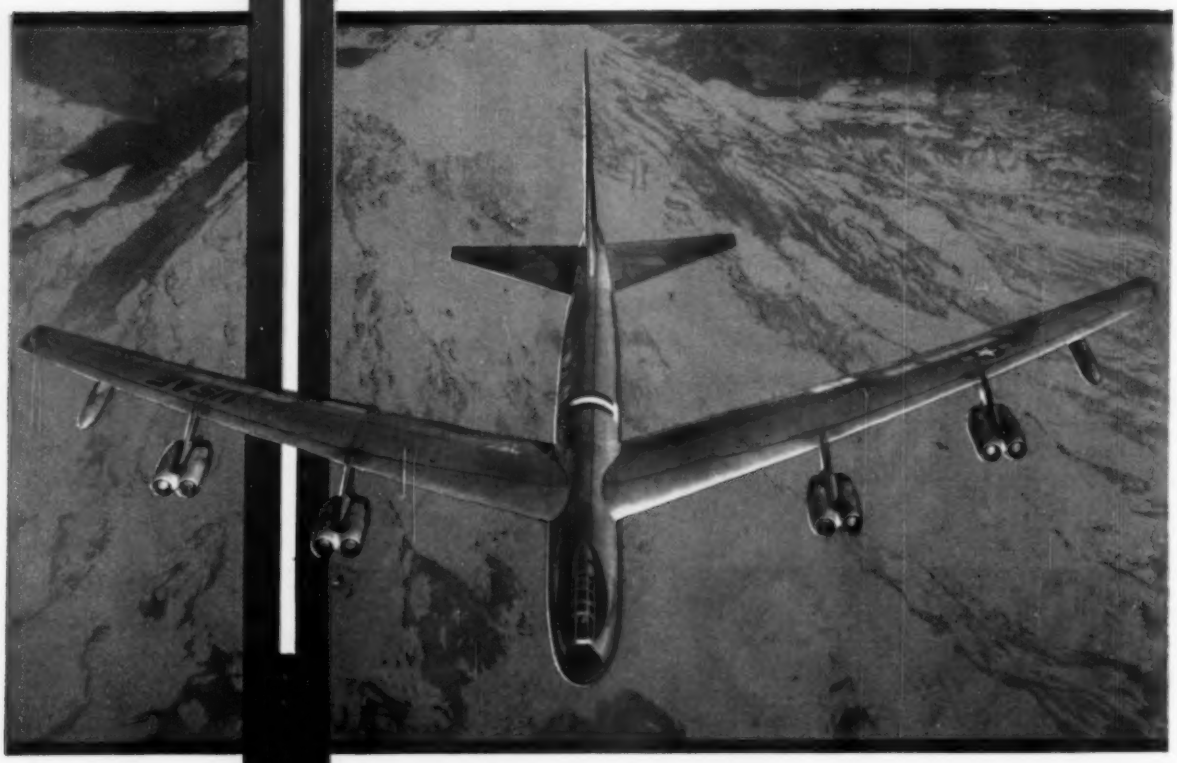
Norwich GLA New York

AIRCRAFT IGNITION AND ELECTRONIC EQUIPMENT

WEST COAST SALES & SERVICE, 3903 Warner Blvd., Burbank, Calif., Victoria 94390

CALLS FOR A HIGH-LEVEL COOLING JOB...



AND HARRISON GETS THE CALL ON BOEING STRATOFORTRESS!

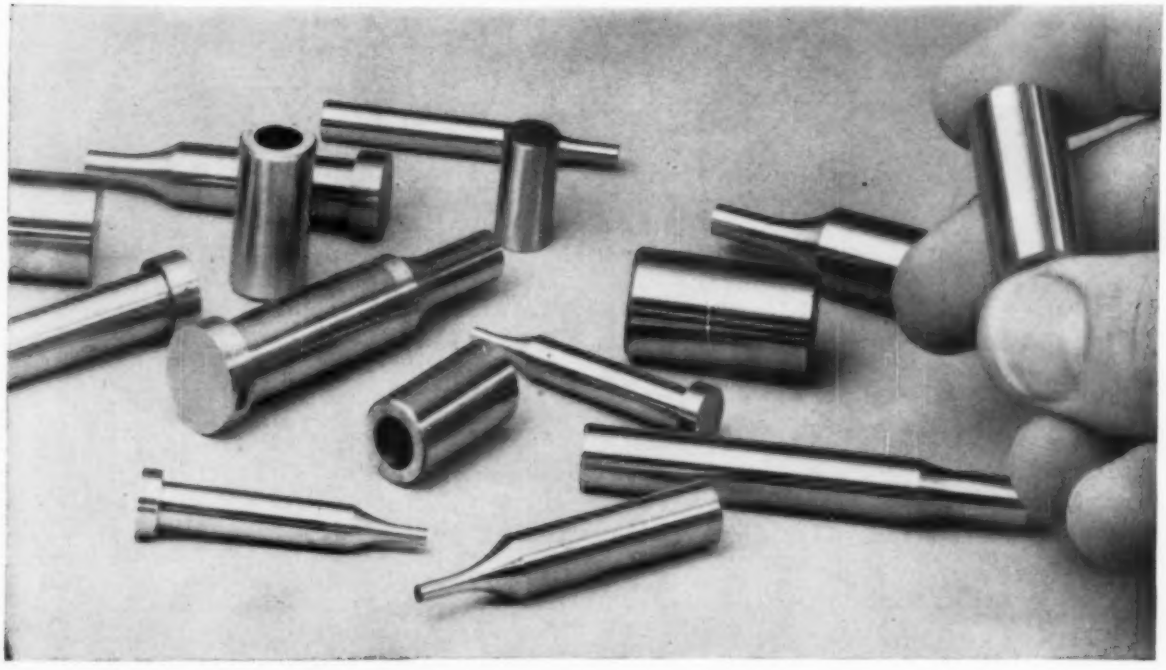
Climbing up to 50,000 feet . . . but Harrison bears down on the heat! Eight highly efficient Harrison aluminum oil coolers maintain vital engine temperatures and assure dependable operation for Boeing's B-52 Stratofortress. Compact design of Harrison heat exchangers saves weight, saves space. Aircraft can carry greater payloads . . . fly higher, farther, faster. Backed by over 45 years' experience, Harrison's research facilities are on a nonstop search for even better ways of doing the job. If you have a cooling problem, look to Harrison for the answer.

TEMPERATURES MADE TO ORDER

HARRISON

RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N.Y.

GM GENERAL MOTORS



How the country's largest exclusive producer of punches and dies changed complaints to contracts

. . . with Graph-Mo® steel

PORTER Precision Products, Cincinnati, Ohio, is the country's largest exclusive manufacturer of punches and dies—37,000 different sizes in stock. Formerly, Porter produced these products from water-hardening and other high-carbon tool steels, but found that such steels presented distinct disadvantages. For example, they distorted in heat treating, were relatively expensive and difficult to machine, and did not meet customers' demands for longer life.

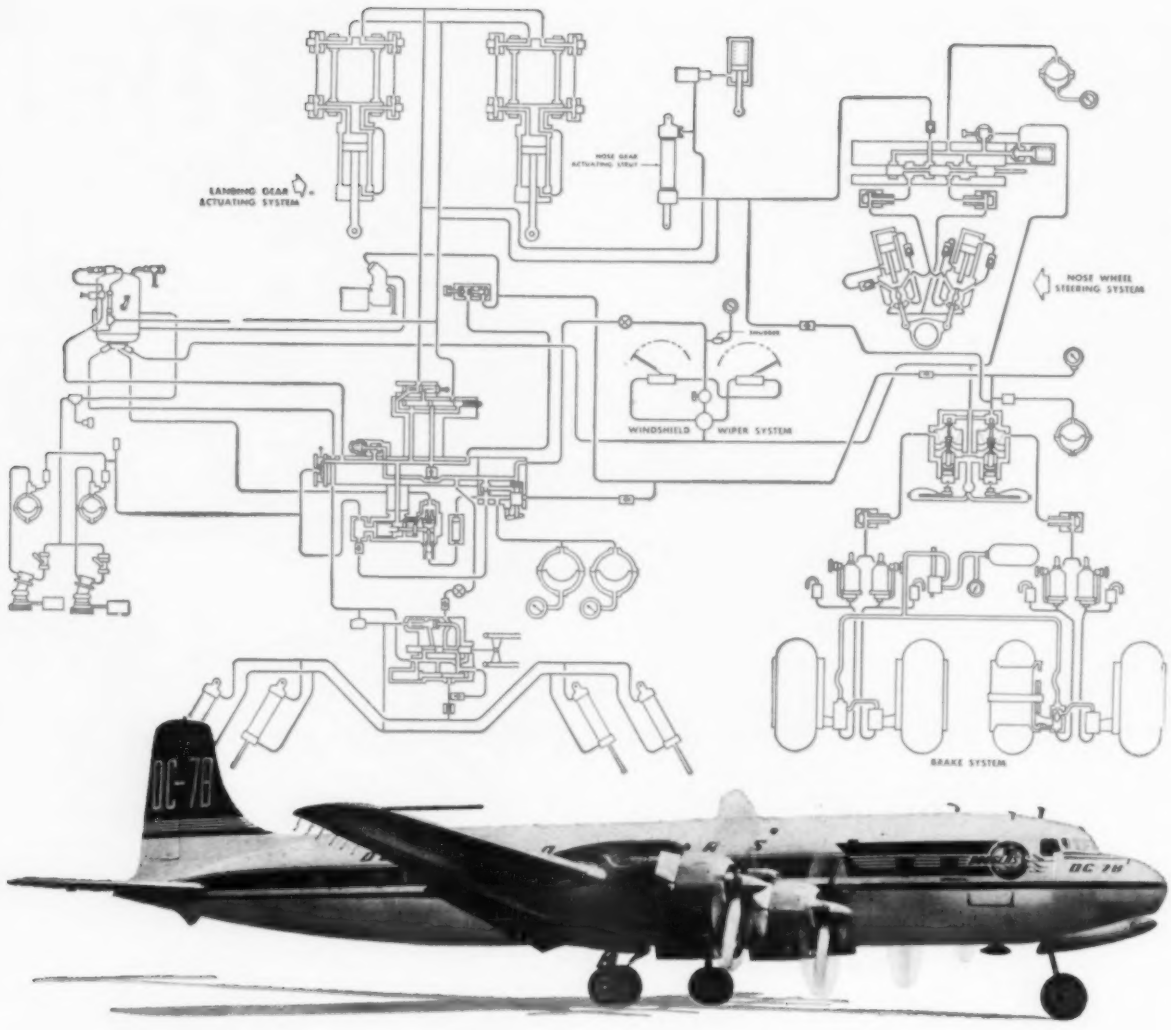
With a view to correcting these problems, Porter engineers adopted Graph-Mo®—one of four graphitic tool steels developed by the Timken Company—as a standard for the manufacture of punches and die buttons. Because it contains free graphite, Graph-Mo is easier to machine. And punches and dies made of Graph-Mo don't scuff or gall. From every aspect, Porter's adoption of Graph-Mo steel has proved eminently successful.

Graph-Mo outwears ordinary tool steels on an average of three to one. Millions of tiny particles of diamond-hard carbide—one of the most wear-resistant substances known—give Graph-Mo steel longer service life.

Graph-Mo may be the solution to *your* punch and die problems. For more information about all four graphitic steels developed by the Timken Company, and their uses in dies, punches, gages, and machine parts, write for the new Timken Graphitic Steel Data Book. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



Enjay Butyl rubber— vital artery in newest airliners

Douglas chooses Enjay Butyl for rubber components of the hydraulic systems in many of its famous DC-7 airliners. These components, which help assure the dependable operation of everything from wing flaps to landing gear, are proving over millions of air miles their durability and resistance to wear.

Versatile Enjay Butyl rubber may well have a place in *your* operation. It will pay you to investigate the many technical advantages it has over other types of rubber. Its price and ready availability are advantages, too. For full information, and for technical assistance in the uses of Enjay Butyl, contact the Enjay Company today.

ENJAY BUTYL

ENJAY *Pioneer in Petrochemicals*

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.
Other offices: Akron • Boston • Chicago • Los Angeles • Tulsa

Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

HOFFMAN makes the complete airborne portion of the TACAN system—another example of Hoffman integrated electronics at work

TACAN is the trustworthy electronic navigation system that unerringly guides pilots through fair and foul weather every second of the flight. Two compact dials on the instrument panel automatically show the pilot his exact distance and direction from a fixed ground station with an accuracy never before attained. Result: greater safety in *any* weather, *any* place.

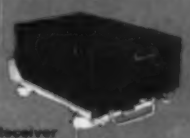
Some of TACAN's advantages over other systems include: three times greater accuracy; handles more airlane traffic—allows planes to fly *safely* at closer intervals; permits starting landing approaches further out—minimizes "stack up" of planes waiting to land; meets military requirements for ruggedness, compactness and mobility.

The same teamwork, experience and facilities at Hoffman Laboratories that put TACAN into full scale production are available for you to use—whatever the size or complexity of your electronic needs. Why not discuss your specific systems engineering problem with a Hoffman Labs' representative soon?

TACAN REQUIRES INTEGRATED SKILLS

Range (distance) indicator
Azimuth (direction) indicator

Control Panel



Receiver
Transmitter
Strobe circuits
Reference pulse detector
Envelope signal detector
Phase comparison circuits

CLOSE TEAMWORK of research, development and production engineering

TECHNICAL ABILITY to achieve maximum component density. TACAN contains as many tubes as four TV sets (plus more than 8,000 other parts), takes up half the space of one TV set

EXPERIENCE AND FACILITIES to field test complex systems in every conceivable weather condition and environment

PRODUCTION KNOW-HOW to build a unit capable of withstanding the rigors of military operations, and the intense G-shock and vibration of carrier deck landings

INITIATIVE to develop and produce complete test equipment to make TACAN in use 100% safe and efficient

A subsidiary of Hoffman Electronics Corporation

Hoffman LABORATORIES, INC.

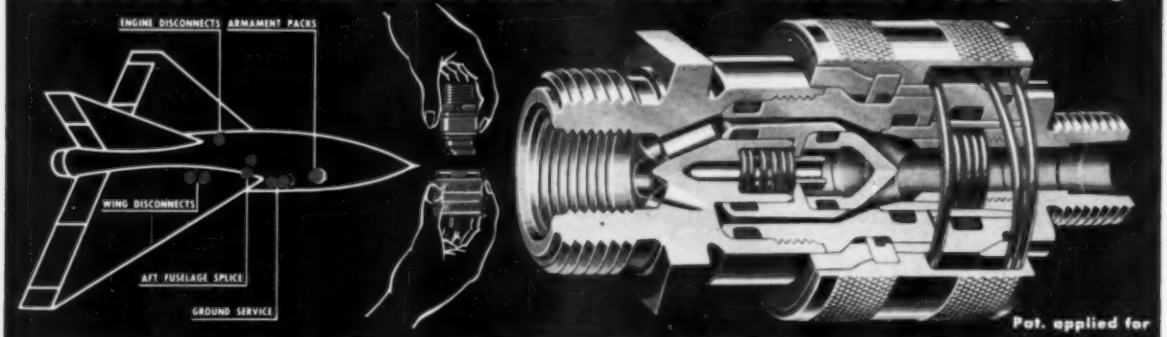
Engineers: For challenging opportunities write: Director of Engineering, Hoffman Laboratories, Inc., 3761 South Hill Street, Los Angeles 7, California

Another WEATHERHEAD *achievement in.....* PRECISION

"Precision Products" is more than a phrase with Weatherhead—it's a tradition . . . the invisible part of any product you buy. It's the reputation for doing certain things better . . . it's progressiveness, ingenuity and pioneering for improvement . . . it's the conscientious coordination of precision methods, men and machines that has carried acceptance for Weatherhead *precision products* the world over. Typical of the precision problems Weatherhead is solving for government and industry is the one shown here. In this case—where so much depends on so little—there's no room for second guessing. "Good enough" just isn't!

Weatherhead's fund of knowledge, skills and experience may be of service to you in your precision products requirements. It costs nothing to find out.

WEATHCO QUICK-DISCONNECT SELF-SEALING COUPLING



Pat. applied for

PUSH ON... PULL OFF...! THERE IS NO PARTIALLY LOCKED POSITION

EASE OF INSTALLATION

The coupling is available with standard fittings and bulkhead flange so that it is readily adaptable to your present and future designs.

EASE OF OPERATION

Push the coupling on!—Pull the coupling off!—It's as simple as that. No twisting or other gimmicks required.

SAFETY

Coupling stays locked, even with repeated accelerations in excess of 35g applied in a direction most likely to cause unlocking. There is no partially locked position.

EXCLUSIVE FEATURES

Fully tested . . . outperforms present and proposed Military Specifications.

Air inclusion negligible . . . uses standard AN and MS "O" rings . . . no special tools required. Oil loss and pressure drop less than specification rate.

For detailed information write for Bulletin AM-12.

THE WEATHERHEAD COMPANY *Aviation Division*

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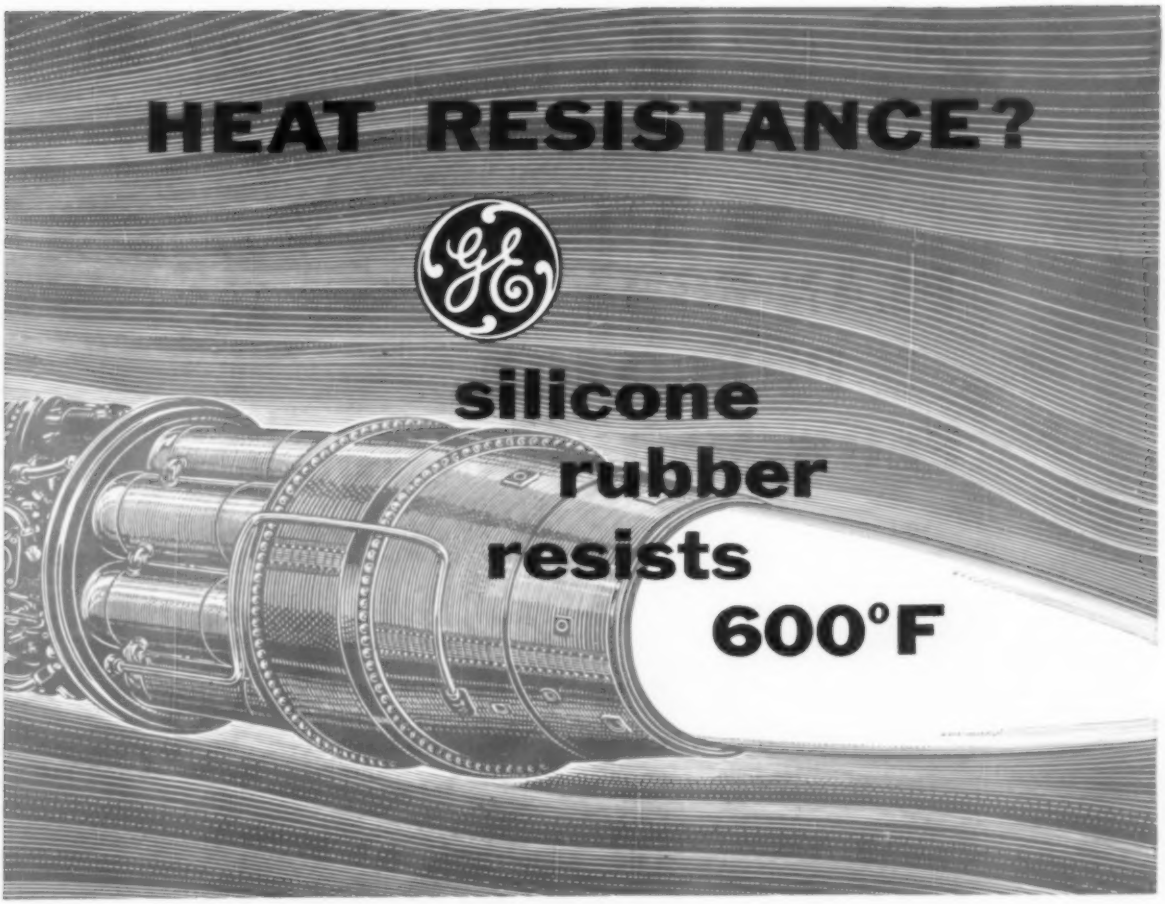
(The Weatherhead Co. of Canada, Ltd.)



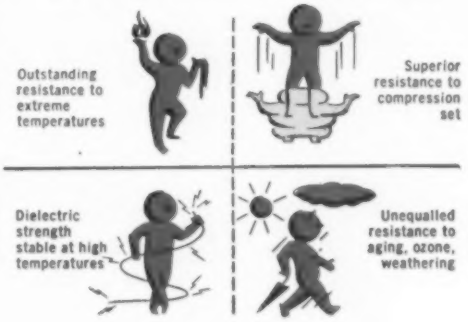
Looking for *really* heat-resistant rubber? General Electric's Class 700 silicone rubber offers serviceability *up to 600 F!* That's why it's being used for aircraft ducting and oven door seals subject to *intermittent* temperatures of 600 F. And it provides *continuous* service at 300-500 F as seals and gaskets in jet engines, diesel engines, clothes dryers, electric cookers, steam irons and heat sealing equipment.

Where can YOU use G-E silicone rubber?

There's a kind for almost every requirement, classified according to dominant property for easy selection and specification. For example: Class 300 offers the best recovery after compression *of any known rubber!* Class 500 provides flexibility *at 150 F below zero!* Which class is best for *you?*

For more details on G-E silicone rubber, see your "Sweet's Product Design File."

G-E silicone rubber provides...


Outstanding resistance to extreme temperatures
Superior resistance to compression set
Dielectric strength stable at high temperatures
Unequalled resistance to aging, ozone, weathering

Send today for a NEW, REVISED "LIGHTNING SELECTOR"!

Progress Is Our Most Important Product

GENERAL ELECTRIC

SILICONE PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY

SECTION 61-38
WATERFORD, NEW YORK

Please send me, at no obligation, technical data on G-E silicone rubber, including a newly revised "Lightning Selector" and up-to-date list of fabricators

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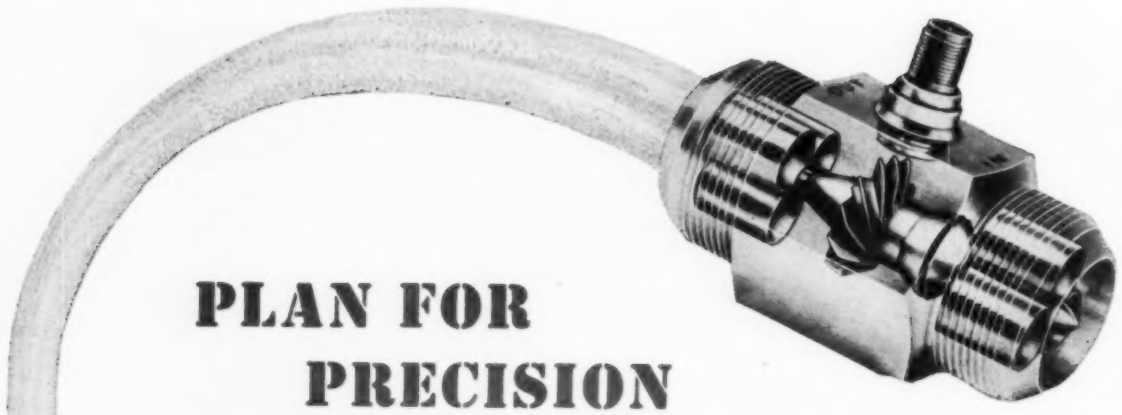

PLAN FOR PRECISION FLOW MEASUREMENT

THROUGHOUT THE AIRCRAFT INDUSTRY, bearingless *Pottermeters* are delivering accurate flow data during testing of aircraft, engines, rocket motors, and hydraulic systems.

LINEARITY WITHIN ½% over an exceptionally wide range, as well as long life in difficult service, is obtained through hydraulic positioning of the unique "floating rotor". This patented design feature, found only in the *Pottermeter*, completely eliminates thrust friction and does away with inaccuracy and maintenance problem due to bearing wear.

APPLICATIONS include reciprocating, jet and rocket engine test cells and flight test work. *Pottermeters* are also in wide use in handling aircraft and rocket fuels, acids, liquefied gases and abrasive suspensions.

WRITE for bulletin S-1 giving a complete description and performance data.

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FROM Alfa TO Zulu...

IT'S AC AIRCRAFT SPARK PLUGS

"From Alfa to Zulu it's Alfa Charlie!" . . . that's the International Civil Aeronautics Organization's newest code for "From A to Z it's AC." Under any and all operating conditions, you'll find AC Aircraft Spark Plugs best for the planes you fly!

For instance, each tip of the AC *three-prong electrode* flares out into a broad base. This feature helps conduct heat away from the electrode more rapidly to greatly reduce damaging erosion. In addition, it provides better scavenging action to reduce fouling, and offers easier, more effective cleaning when plugs are reconditioned.

Get AC Aircraft Spark Plugs with the *three-prong electrode* for the planes you fly!

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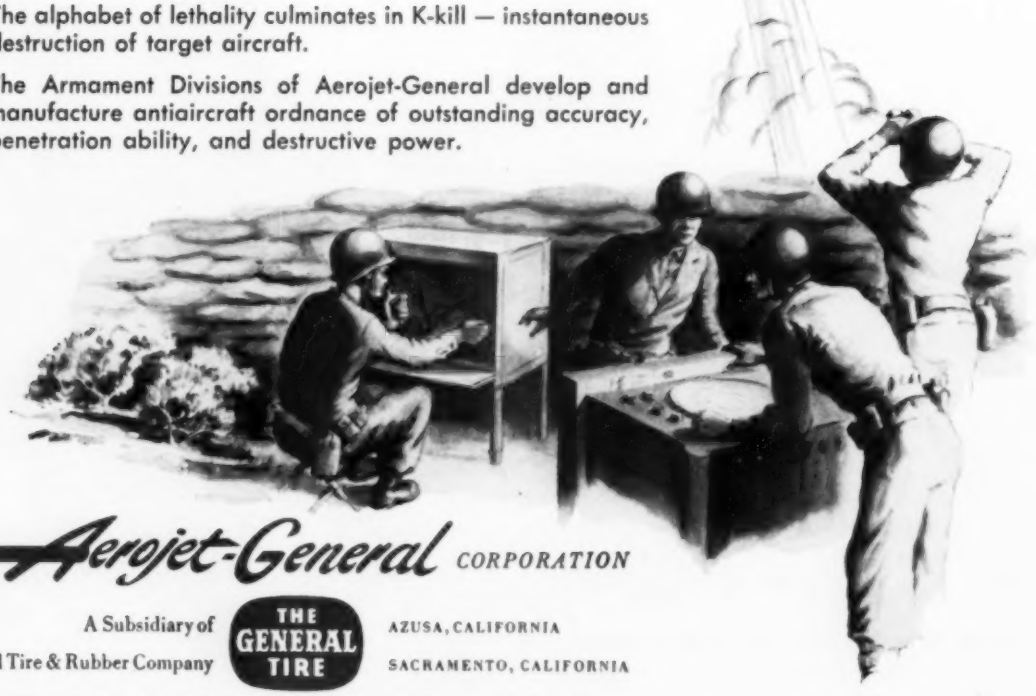
AS EASY AS A, B... K

The alphabet of lethality culminates in K-kill — instantaneous destruction of target aircraft.

The Armament Divisions of Aerojet-General develop and manufacture antiaircraft ordnance of outstanding accuracy, penetration ability, and destructive power.



Aerojet-General CORPORATION

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MORE POWER FOR AIR POWER

Ordnance Rockets • Gun-Boosted Rockets • Pyrotechnic Rockets and Signals • Guided Missile Warheads • Rocket Launchers
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27 FOOTBALL FIELDS

UNDER ONE ROOF

The mammoth size of the Hayes Aircraft plant at Birmingham, Alabama, is an important factor in the Company's record of volume production, high quality workmanship, schedule-integrity and moderate cost in performing maintenance and modification contracts.

Floor space of the huge Hayes plant is equivalent to 27 standard football fields. The facility embraces 10 manufacturing bays . . . each 40 feet high, 160 feet wide and 725 feet long . . . all under roof. The total covered area is 1.25 million square feet. Total area, including supporting buildings, runways and paved aprons, exceeds 5 million square feet.

Size plus modern equipment, plus capable engineering, plus skilled craftsmanship give Hayes a place in the forefront of America's aircraft modification industry.

POSITIONS OPEN FOR ENGINEERS

With nearly 6,000 employees, Hayes is now a competitive industrial facility for modification and maintenance of aircraft — including largest size planes.

Opportunities open for experienced design engineers, graduate and undergraduate engineering students. Write Personnel Department.

Front of one of Hayes 10 bays open, showing production lines inside.

ENGINEERS • DESIGNERS • MANUFACTURERS

Hayes

AIRCRAFT CORPORATION

BIRMINGHAM, ALABAMA

double indemnity!

The versatility of the USAF Tactical Air Command . . . its mobility and atomic capabilities . . . combine with Ground Support equipment to provide assurance of effectiveness ***when seconds mean survival .*** ▷ Ground Support equipment of unquestioned reliability is indispensable should the need of defense or retaliation demand that TAC "rise" to the occasion in protection of our freedom. ▷ Through design, development and manufacture, we have solved the most complex ground support problems . . . providing the Tactical Air Command with a self-propelled multi-purpose unit, which combines towing, testing, servicing and/or starting for all types of aircraft under the most difficult operational conditions. The M A-1 and other type ground support units. are now being used extensively by the USAF, Navy and Marines . . . and are ***consolidated for greater power and versatility.***

THE ALL-PURPOSE MA-1 HELPS GREATLY TO SOLVE THE MOBILITY PROBLEM . . . FOR ONE UNIT TAKES THE PLACE OF FOUR OR FIVE

IN THE EXACTING FIELD OF GROUND SUPPORT, CONSOLIDATED HAS DEMONSTRATED ITS ABILITY TO MEET THE MOST COMPLEX DEMANDS

CONSOLIDATED
DIESEL ELECTRIC CORPORATION

STAMFORD, CONN. BRANCHES · DALLAS, TEX. · DAYTON, OHIO · SANTA ANA, CAL. · WASHINGTON, D. C.
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NOW . . . DOUGLAS
specifies World's Fastest
Fire Detector to protect
USAF's GIANT C-133A
Speed-of-light response . . . and reliability of detection . . . are the vital factors of safety essential for the harnessed volcanoes in today's aircraft. Now FIREYE* stands guard in the Douglas C-133A, the world's largest cargo-carrying aircraft. A growing number of plane builders have chosen FIREYE for maximum protection from fire aloft. Write for complete information.
*Protected by U.S. and foreign patents issued and pending.
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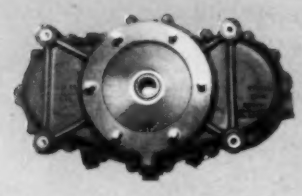
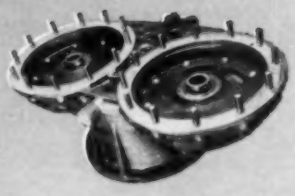


Dual accessory drive unit, rated at 40 HP at constant 3200 RPM, weight 16½ lbs.

For use on VTO aircraft, accessory drive weighs only 14 lbs. Operates on input of 35 HP at 5500 RPM. Two power take-offs operate at 7810 and 4350 RPM.



Accessory drive designed for North American, weighs 38 lbs. 70 HP input at 6000 RPM. Two power takeoffs at 6000 RPM each.

Designed and manufactured for Boeing KC97. Approximate weight 10 lbs. Six horsepower (continuous duty) input at 6000 RPM operating one power take-off drive at 2620 RPM.

Combination engine starter and accessory drive for Chance-Vought F8U-1 Navy Fighter. Ten horsepower (continuous duty) driving hydraulic pump at 4200 RPM. 55 HP intermittent service. Continuous input speed 7000 RPM. Weight 27 lbs.

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can solve your accessory drive problems!

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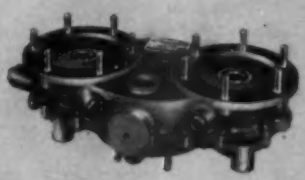
Dual hydraulic pump adapter, rated at 35.7 HP at 6000 RPM, weight 26 lbs.

For Convair T-29. Approximate weight 13½ lbs. Input horsepower 103. Input speed 4000 RPM. Two power take-off drives operate at 9600 RPM each.



For use on fighter aircraft, 75 HP input at 7000 RPM. Two power take-offs, 35 HP at 3630 RPM and 37 HP at 3820 RPM. One pad for starting J-75 engine. Capable of 6600 inch-lbs. starting torque.

'AY 21, 1956

AVIATION WEEK

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EDITORIAL

Mid-Way in Airpower Budget Battle.. 21

COVER: Douglas C-133A, shown on its first flight last month, is now at Edwards AFB for flight tests. The USAF transport is designed to airlift 50 tons of cargo. Turboprop engines are 5,700 eshp. Pratt & Whitney T-34s.

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AVTRIM FLIGHT RUGS

Stepped on 83,335,200 times without losing face

THIS "airplane flight deck" is inside a B. F. Goodrich plant. It is a rough wood ramp covered by test mats of Avtrim flight rugs in 10 colors, 5 finishes. During a six-year test recently concluded some 83,335,200 footsteps pounded the Avtrim surface. Yet, when taken up, the face of the rug was still serviceable, the colors bright as new.

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EDITORIAL

Mid-Way in the Airpower Budget Battle

At the halfway mark in the battle over the Fiscal 1957 airpower budget, the Eisenhower Administration has reacted strongly to the public prodding of its military and civilian critics who contended that the original airpower budget submitted to Congress was grossly inadequate.

The administration now agrees with the major points of this criticism if not in full degree with the solution required. Before the Fiscal 1957 Defense Appropriation Bill reached the House of Representatives floor for debate and vote the administration asked for a $547 million boost including the key areas of B-52 procurement, early warning radar network and missile research. At the same time about $89 million was thawed from the frozen funds of the Defense Department emergency account and made available for Air Force research and development.

House Approved Boost

With this substantial boost included in the bill the House unanimously approved it by a vote of 377 to 0. An ill-considered amendment by Rep. Dan Flood (D.-Pa.) to tack on another billion dollars for B-52 procurement was swamped by the more thoughtful members of the House.

For the problem that now remains in the airpower budget cannot be solved by additional procurement funds alone. It requires more personnel and construction funds before USAF can receive and maintain its new aircraft properly and more research and development funds to keep its technical pace at maximum speed.

In addition to conceding its critics the half billion dollar budget boost, the administration is now trying to convince the American people they have and will keep superior airpower.

There has never been any question that we now have the most powerful airpower in the world. The big question is whether we will maintain a significant margin of superiority in the future.

After banning massed military airpower fly-bys over Washington since the Eisenhower inaugural in 1952 for alleged safety and economy reasons, the Defense Department has now authorized the largest mass flight in history over the Capitol on Armed Forces Day.

It has begun to trumpet the strength of the total military airpower available from the Army, Navy and Marines in addition to the Air Force. This is a thesis with which nobody can quarrel. However the specific contributions of these other services air forces should be examined in detail to determine in what manner and degree they contribute to the main airpower mission of massive retaliation and its secondary mission of a air defense.

Senate Research Debate

Airpower debate in the Senate will probably center on the remaining deficiencies in research and development and in facility construction funds. It is apparent from testimony before both House and Senate Appropriations Committees that all of the top USAF civil and military leaders except USAF Secretary Donald Quarles agree that more research and development funds are an urgent USAF requirement. It appears doubtful that the Senate will let Secretary Quarles single-handed veto of USAF requests for more research and development money stand —particularly since it is a small but significant amount totalling not more than $200 million. It also is likely that some additional construction money will be attached to the military public works bill for key Strategic Air Command bases and research and development test facilities.

Thus it appears that the Fiscal 1957 airpower budget will emerge from Capitol Hill considerably stronger than when it was submitted in January. It also appears that most of the critical pinches such as B-52 production, research and development and facility construction will be much relieved. There is no doubt that if this happens this country will continue to hold its airpower lead for another year.

Next Year Critical

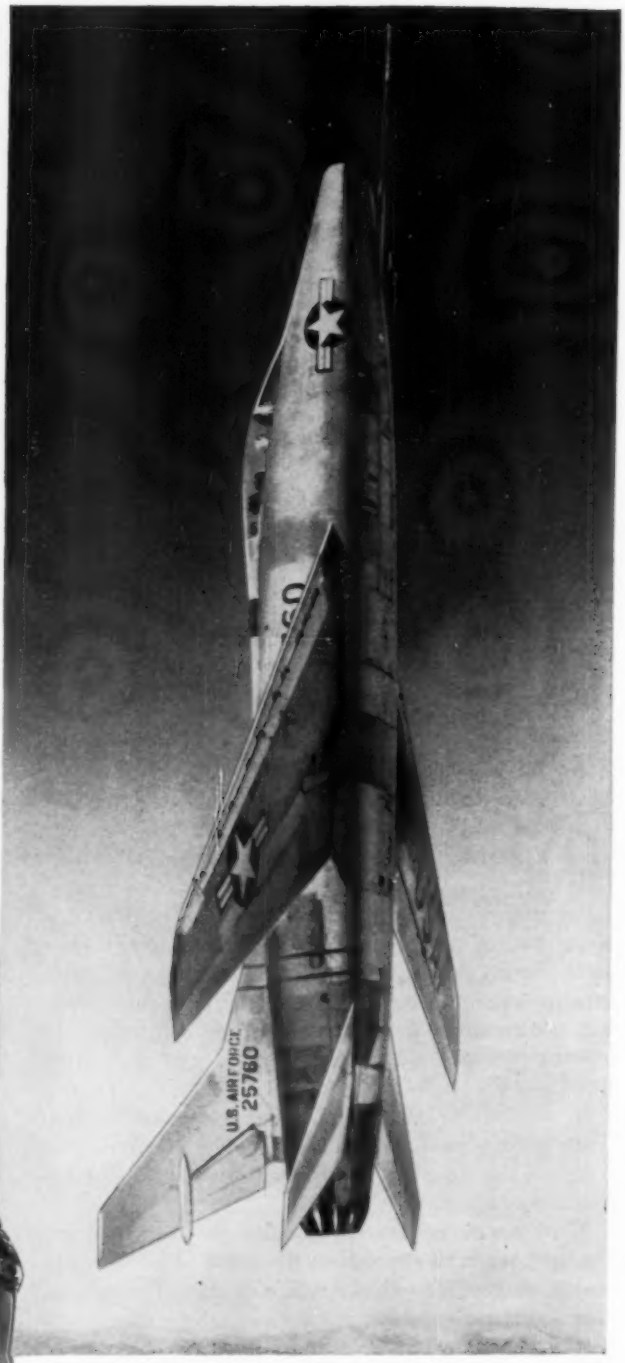
However, it is apparent that the really critical battle of the budget will occur over the Fiscal 1958 budget just a year hence. Both USAF and Navy officials have indicated that the Fiscal 1957 budget level has been achieved by a variety of "one-shot" economies that cannot be repeated in the future, such as buying only 10 months aircraft production instead of 12, postponing necessary base and test facility construction and slowing research and development.

USAF Secretary Donald Quarles has made it unmistakably clear to both the House and Senate Appropriations Committees that a major increase in the Fiscal 1958 airpower budget will be required to continue expansion of USAF to its 137 combat wing program and maintain its qualitative superiority. Similar increases on a smaller scale will be necessary for naval aviation as its technology comes of age.

The Fiscal 1957 battle of the airpower budget is virtually won. It is toward the more critical battle looming for Fiscal 1958 that the American people and its Congress should begin to direct their attention.

—Robert Hotz

The North American Super Sabre streaks for altitude at supersonic speed.



up on its tail—of TITANIUM

Most of the tail section and many other vital parts of North American's F-100C supersonic fighter are made of titanium. It not only reduces gross weight by several hundred pounds, it withstands the searing combination of engine and aerodynamic heat.

Titanium is no stranger to North American aircraft. The first F-100, FJ-4 and earlier planes like the F-86D Sabre Jet and the FJ-2 and FJ-3 Furies for the Navy all fly with titanium.

Here's why—Titanium's high strength-weight ratio . . . its freedom from stress corrosion cracking . . . its corrosion resistance . . . and its ability to withstand high operating stresses have made it an *essential* part of high-performance aircraft.

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WHO'S WHERE

In the Front Office

George Marglin, executive vice president, Aeroflex Laboratories, Inc., Long Island City, N. Y. Also named to vice president posts; General Manager **R. G. Sanders**, Engineering Director **E. H. Pallme** and Sales Director **M. J. McCormack.**

Dr. Ralph P. Johnson, and **Frederick C. Crawford**, directors, Ramo-Wooldridge Corp., Los Angeles, Calif.

Dr. Charles R. Burrows, engineering vice president, Ford Instrument Co., New York, N. Y., effective July 1.

F. J. Gaffney, engineering vice president, Teleregister Corp., Stamford, Conn.

Honors and Elections

Vice Adm. Charles E. Rosendahl, (USN, ret.), has been awarded a Certificate of Honor from the Air Force Assn. for his direction of National Air Transport Coordinating Committee's community relations program including voluntary plane noise procedures.

Lt. Col. Ernest J. Fawbush (USAF), commander, 29th Weather Sqdrn. and Maj. Robert C. Miller (USAF), officer in charge, Severe Weather Warning Center, Kansas City, Mo., have been presented with the American Meteorological Society's Meisinger Award for their pioneering studies of the genesis and practical prognosis of tornadoes and other destructive local storms.

Two international awards will be sponsored by Greer Hydraulics, Jamaica, N. Y. One award provides $1,000 and a plaque for the solution of the most important current public relations problem confronting the aviation industry. Initial choice: "greatest contribution in suppressing noise in jet aircraft between now and delivery of the first commercial jet transport in 1958." Second award, $500 and a plaque, will be an annual presentation for solution of an aircraft engine or accessories maintenance problem.

Changes

F. G. R. Cook, director, Royal Air Force fighter aircraft research and development, Ministry of Supply. He succeeds **Air Commodore J. A. Hawkins.**

Robert S. Butts, chief engineer, Melpar, Inc., Falls Church, Va.

William D. Orr, military relations department manager, Lockheed Aircraft Corp. Missile Systems Division, Van Nuys, Calif.

Wayne K. Hodder, senior development engineer-airborne instrumentation systems, Datalab, Consolidated Electrodynamics Corp., Pasadena, Calif.

Dr. Severin Raynor, director, American Machine & Foundry Co. Mechanics Research Department, Chicago, Ill.

John C. Heiner, in charge, Hawaiian Airlines agency and interline sales office.

Louis B. Haberman, general manager, Test Equipment Division, Consolidated Diesel Electric Corp., Stamford, Conn. Also: **Julian A. Licht**, foreign technical manager.

(*Continued on p. 127*)

INDUSTRY OBSERVER

► Ten major airframe companies are sweating out USAF evaluation of their study proposals for the medium-range interceptor competition. USAF is due to award Phase I contracts for the medium-range interceptor soon. Fears that this competition might be canceled due to research and development fund limitations have been eased by the USAF decision to cancel the long-range interceptor and fighter-bomber Phase II programs. Medium-range interceptor mission calls for hitting enemy targets about 800 miles out as compared with the 1,500-mile strike range of the long-range interceptor.

► **Douglas F5D prototype is in Phase I flight testing at Edwards AFB with Robert Rahn, company test pilot, at the controls. Larger vertical fin is the main characteristic distinguishing it from the F4D, but it is powered by a General Electric J79 turbojet replacing the Pratt & Whitney J57 in the Skyray.**

► Joint Army-Navy intermediate-range ballistic missile project has been designated the Jupiter. Army has changed the designation of its Redstone 200-mile range missile to the Jupiter A and the new 1,500-mile range joint project is designated Jupiter C.

► **Russia's Tupelov 104 twin-jet transport has been assigned the NATO code designation Camel.**

► First deliveries of the Douglas F4D Skyray have been made to the Navy's Atlantic and Pacific fleet air commands and to the Marine Corps. The F4D has qualified on all three types of Navy heavy attack carriers—the Forrestal, Antietam and Midway classes—and has recently completed its fleet introduction test program. Initial deliveries of the F4D are being made with radar equipment and fire-control that will be further modified to provide full all-weather capability by mid-summer. F4D has distinguished itself particularly for high speed and maneuverability performance at altitudes well above 55,000 ft.

► **Convair is developing an extensive array of development test equipment for its Atlas intercontinental ballistic missile program including a continuous-wave radar high-altitude tracking system.**

► Lockheed's solution to pilot survival in supersonic bailout in the F-104's downward ejection consists of part of the cockpit structure going with the seat to protect the pilot from airblast. Not believing in jettisonable pods, Lockheed has made the jettisonable portion a part of the seat structure. Tests are scheduled for early this summer at Hurricane Mesa as part of Project Smart.

► **Photostress, a visual stress analysis tool, is being imported from France for progressive fatigue and stress reaction in in-flight dynamic gust loads. A thin layer of clear plastic (probably epoxy) is sprayed or laminated on the airframe and, the stress patterns are examined through a polaroid.**

► Lockheed has developed a three-stage hypersonic test vehicle for ballistic missile research designated the X-17. It uses solid propellant rocket motors.

► **Joint Air Force-Navy program is under way to develop expendable pylons for externally-mounted wing stores. Concept calls for leaving highspeed aircraft with an aerodynamically-clean wing after using externally carried fuel and disposing of externally-mounted armament. Current practice is to use fixed pylons for mounting these disposable items.**

► Curtiss-Wright dual cycle engine combining turbojet and ramjet powerplants has made successful transitions from one power source to another in full scale wind tunnel tests with simulated flight conditions. The dual-cycle engine is scheduled for the Republic F-103 experimental research aircraft.

► **Bristol BE25 turboprop engine is named Orion, after a hunter in Creek mythology. Production goal is early 1959.**

FOR 3000 PSI PNEUMATIC SYSTEMS

SOLENOID VALVES
REGULATORS
INTERLOCK VALVES

Stratos' Western Branch now is turning out solenoid valves and pressure regulators for 3000 psi pneumatic systems. Light, reliable, precision-built, they complement the large group of Stratos pneumatic equipment for aircraft.

Model 7008 solenoid valve assembly

Exploded view of Model 7006 solenoid valve core, assembly and body

Model 7009 solenoid valve core

Photos not to scale

Solenoid valves are made in two types, each produced as: normally closed, normally open, and normally closed with manual override. Designed for continuous duty in aircraft pneumatic systems, Stratos 3000 psi solenoid valves are compact, light, and simple to install. Drawing less than 1 amp, they are fast acting (0.020 sec.) and their reliable performance remains unaffected by temperatures of −65°F to over 165°F.

Flow capacities are equivalent to a 0.040" sharp edge orifice for the direct-operated size and to 0.312" for the larger air relay type. The solenoid of the smaller model is used in the higher-flow air relay unit.

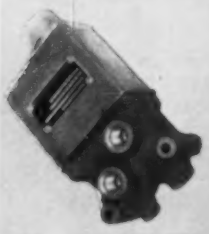
Both types are available as either complete units—or as core and seat assemblies which can be threaded into housings integral with the mechanism to be controlled.

Model 7002 pressure regulator

Pneumatic Pressure Regulators by Stratos provide a wide range of adjustable downstream pressures and are designed to operate with 3000 psi supply.

The high flow model, with a flow capacity equivalent to a .115 diameter sharp edge orifice, can be adjusted to downstream pressures from 400 to 1500 psi. Downstream proof on this pilot operated unit is 5000 psi.

The poppet-type, medium flow regulator illustrated delivers a capacity equivalent to a .035 diameter sharp edge orifice, adjustable downstream pressures range from 100 to 800 psi., proof pressure is 1500 psi.



INTERLOCK VALVE
pneumatic/electric

Pressure:
Rated 400 to 1500 psi.
Proof 3000 psi.
Burst 4000 psi.

Control: Mechanical. Interlock switch rating at 30 V dc or 250 V ac is 10 amps.

Weight: 1.2 pounds

Ambient temperature range: −60°F to 165°F.

Provides pneumatic and electrical interlock to prevent premature energization of devices in series with actuator of interlock valve.

For more complete data on Stratos' 3000 psi solenoid valves and pressure regulators, write to: Stratos' Western Branch, 1800 Rosecrans Avenue, Manhattan Beach, California

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WASHINGTON ROUNDUP

More R&D Funds?

Defense Department may ask for more research and development funds for the Fiscal 1957 budget as a result of a review of R&D needs now under way. The study is expected to be completed by July 1. Supplemental appropriations requests, however, probably would not be made until after the November elections.

North Atlantic Fares

Civil Aeronautics Board has issued a policy statement on North Atlantic fares which gives strong support to Pan American World Airways' proposal for a cut-rate, third-class air service.

Since it was CAB's strongly-worded attack on International Air Transport Assn. fares last February that started a growing dispute among IATA members, CAB's position is important. The policy statement gives IATA a definite yardstick for measuring fare proposals made by members at their meeting in Cannes, France, on May 29. CAB's statement said the major issue at Cannes will be establishment of fares and service standards on North Atlantic routes, where—the Board feels—present tourist fares can't reach the large traffic potential.

CAB is convinced the solution lies in a high-density, low-cost service similar to that proposed by Pan American (AW May 14, p. 39). The Board's policy favors making the new service a third-class, leaving tourist and first class service as they are. The Board favored Pan American's roundtrip New York-London fare of $391.50. It said a deadline of April 1, 1957, is reasonable for inauguration of a new low-cost service.

Study of Air Needs

White House aviation aide Edward P. Curtis has taken the first step toward development of a national aviation plan by awarding contracts for a study to determine civil and military aviation facility needs for the next 20 years. The study is supposed to recommend ways of meeting the problems it finds, and to outline legislative, organizational, administrative or budgeting steps necessary to implement the comprehensive plan which Curtis' group will develop. The $300,000 contract was split between the Aeronautical Research Foundation and the Airborne Instrument Laboratory, in cooperation with the Cornell Aeronautical Laboratory.

Atlas Plant Hassle

Air Force and Navy are hassling over the location of Convair's production plant for the Atlas intercontinental missile. Convair was to break ground this month on a 280-acre site in Sorrento Canyon, near San Diego, Calif., (AW May 7, p. 31). Now it turns out that the plant site is just within the perimeter of the jet flight pattern for Navy's Miramar air base. The services are tossing queries from the press around like hot potatoes. Final clarification may come from Defense Department level.

B-52 Rejections

The faulty part that caused the crash of one Boeing B-52 bomber and the USAF's temporary rejection of 31 production models was not an alternator, as the Air Force first announced (AW May 14, p. 34). It was, the Air Force now says, a turbine drive wheel connected to the alternator. Confusion apparently stemmed from the fact that the alternator and turbine, when connected into a unit, are referred to by Boeing as "the alternator package." Westinghouse makes the alternators and General Electric and Thompson Products make the turbines. Faulty turbines, which had met USAF specifications, were made by Thompson. These specifications have now been changed, and Thompson is continuing to make turbines under the new specifications. To confuse the confusion further, the Air Force announcement referred to the turbine wheel as a "flywheel" inside the alternator. Alternators don't have flywheels and neither does an "alternator package."

More Defense Secretaries

Defense Department plans to add one more assistant secretary for each of the services. In the Army and Navy the new assistant secretary would be for research and development; in the Air Force, for installations. USAF already has an assistant secretary dealing exclusively with R&D. In the Navy, the Assistant Secretary for Air now also handles research and development. Army's R&D is managed by a "director" in the office of the Secretary.

The three new ones would raise the total of defense secretaries, subject to Senate confirmation, from 30 to 33. The new posts will require legislation.

Army Aviation Plan

Army's five-year aviation program, still before the Joint Chiefs of Staff for consideration, is being presented with emphasis on its full compatability with Air Force missions. So far, there is no evidence that the plan, drafted by Maj. Gen. Hamilton H. Howze, marks any radical departure from accepted Army aviation practices. It does necessitate modification of any limitations on the size of Army aircraft, or on the type of propulsion and range. It also looks forward to development of a turboprop fixed-wing plane for observation purposes (AW May 14, p. 31), a project that will go ahead once agreement is obtained with the Marines on specifications.

Price-Cutting Pressure

In preparing its Fiscal 1957 budget requests, the Air Force estimated it would be able to recoup $500 million during the year through readjustments on outstanding contracts. The Defense Department replied that the figure should be $1.1 billion, and cut $500 million from USAF's budget request. What it adds up to is that if USAF cannot recoup the $1.1 billion it will have to go back to Congress for more money to support its activities.

Gardner Becomes Hycon President

Trevor Gardner, who resigned his post as Assistant Secretary of the Air Force for Research and Development last February in protest against the lack of research-and-development funds, has been elected president of the Hycon Manufacturing Co. with headquarters in Washington. Gardner, named board chairman of the firm shortly after his resignation as Assistant Secretary, succeeds Alden E. Acker who resigned as Hycon president and director.

—Washington staff

Service Chiefs Hedge on Budget Support

Twining, Burke say more R&D funds could be used effectively; USAF doubts Navy's strategic role.

By Katherine Johnsen

Washington—Top Air Force and Navy officials last week began to hedge earlier support of the administration's airpower budget for Fiscal 1957. In testimony before the Senate Appropriations Subcommittee on the Armed Services, these facts came out:

• **Gen. Nathan Twining, USAF Chief** of Staff, and Chief of Naval Operations Adm. Arleigh Burke, testified that additional funds for research and development could be used "effectively" in the coming year.

• **Both Secretary of the Air Force Don**ald Quarles and Burke warned that larger appropriations for aircraft and related procurement would be required in Fiscal 1958—in view of numerous "one time" savings in the Fiscal 1957 budget, such as a calculated reduction in procurement lead time.

• **Twining recommended** an additional $275 million for bases and other construction—which, he emphasized, is the major bottleneck in the 137-wing program, along with technical manpower.

• **Twining challenged Navy** testimony that carrier airpower "significantly augments" the nation's strategic power and that there are "very few" targets out of reach of the Navy's attack bombers. In the initial and critical phase of a major war, Twining declared, the Navy's contribution to the strategic air capability would be small.

• **Army's Chief of Staff,** Gen. Maxwell D. Taylor, protested that the USAF's program to man bases with the Navy-developed Talos missile was invading the Army's air defense mission. Sen. John Stennis (D.-Miss.), a member of the Appropriations Committee, declared that he will "insist" on a test of the relative merits of the Talos and the Army's high-touted Nike B missile, both in the development stage, before any funds are used for their procurement.

House Approval

The Senate Subcommittee opened hearings after the Democratic-controlled House approved, 377 to 0, the administration's program providing $15.5 billion for the USAF and $2.5 billion for Navy aviation (AW May 14, p. 27). An amendment offered by Rep. Daniel Flood (D.-Pa.) adding $1 billion for B-52 procurement was voted down on a voice vote. Flood cited the testimony of Gen. Curtis LeMay, commander of Strategic Air Command, that strategic air superiority would pass to the Soviet Union within four years, unless the B-52 program were stepped up.

Leading the opposition to Flood's proposal, Rep. George Mahon (D.-Tex.), chairman of the Appropriations Subcommittee on the armed services, declared: "why make a gesture of fiscal irresponsibility . . . if we could snap our fingers and bring into being today 1,000 additional B-52s, we would not necessarily be a great deal better off. We would not have the men to man them, the mechanics and technicians."

During the House debate, Rep. L. Mendel Rivers (D.-S. C.), hit at the administration's $5 billion slash in USAF funds—primarily for manpower and construction—in 1953, declaring:

"In 1953, the USAF had 106 wings, supported by 977,000 military personnel. In 1957, USAF is supposed to have 137 wings. To operate and maintain this force, USAF is expected to do so with 936,000 personnel. Even a man like Houdini could not overcome an impossible situation such as this . . .

"In 1950, USAF had only 47 wings and 122 bases in the U. S. by 1955, the number of wings had increased 160%; the number of bases, only 40%."

Senate Testimony

When the hearings switched to the Senate, these were among the highlights:

• **Quarles testified** that the Air Force is considering contracting with private organizations and industrial firms to supply the technical maintenance personnel at its bases as a possible step towards alleviating the acute technician shortage. He said, however, that he preferred military personnel which could be required to move with operational units.

• **Quarles and Twining** countered Gen. LeMay's testimony before the Armed Services Subcommittee, headed by Sen. Stuart Symington (D.-Mo.), emphasizing requirements for B-52 production by pointing to B-47 fleets as "the largest and most powerful strategic bomber force in existence." LeMay had viewed the Russian jet Bison bomber as comparable to the B-52. Twining said the B-52 is "the best long-range bomber in the world today." Under questioning, he also said he wanted no additional funds—over and above the administration budget—for B-52s.

• **The total cost** of the B-52 program, including research and development costs, is $5.7 billion, it was disclosed. Of this, $2 billion is in the Fiscal 1957 budget—almost a third of the total $7.6 billion for all aircraft and guided-missile procurement and modification.

• **Of the total $1.6 billion** for Department of Defense research and development activities during Fiscal 1957, $527 million is for contracts in the field of aircraft and guided missiles and related equipment.

• **A total $5.2 billion** is earmarked for research and development, plus production engineering. Over half of this, $2.6 billion plus, is for missile projects. This is divided: USAF, $1.4 billion; Army, $862 million; Navy, $356 million.

• **Dr. Clifford C. Furnas,** Assistant Secretary of Defense for Research and

USAF Cancels Interceptor, Fighter-Bomber

Washington—As Congress wrestled over its Fiscal 1957 budget requests last week, the Air Force decided to abandon development contracts for a long-range interceptor and a new-type fighter-bomber. The principal reason, a lack of research-and-development funds, both present and anticipated.

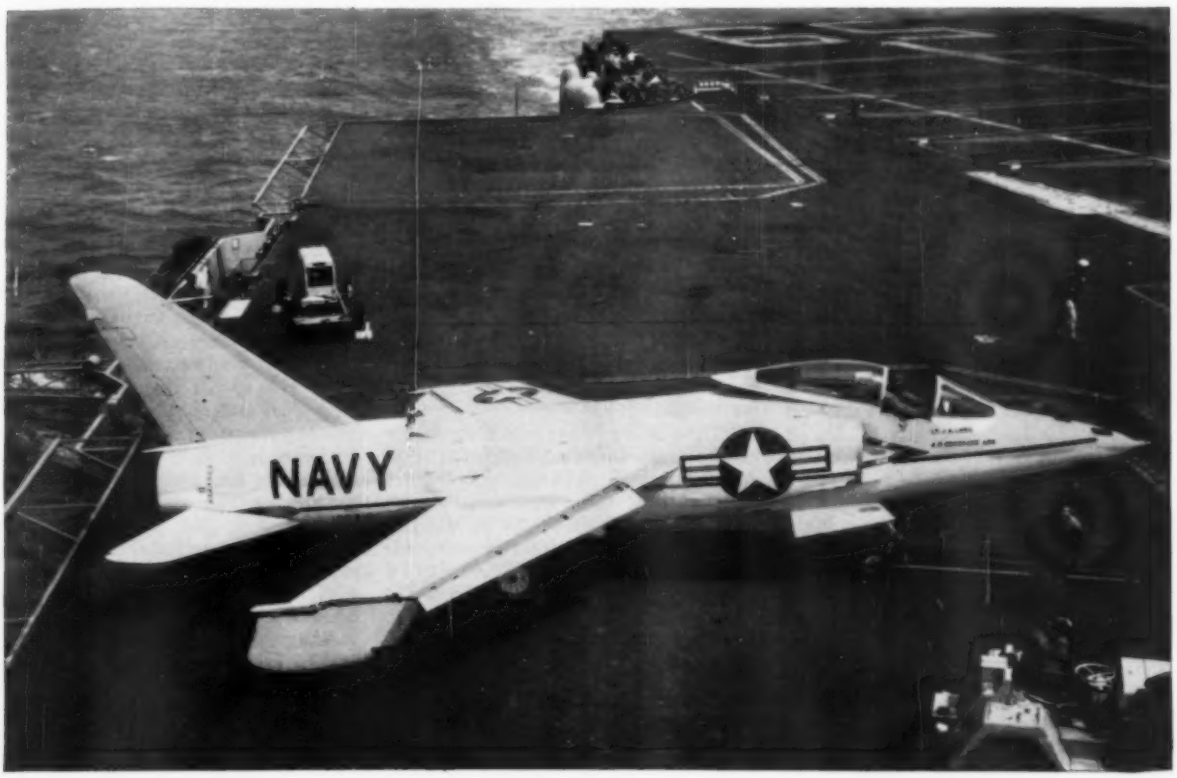
Hardest hit by the decision, forecast by Aviation Week on Feb. 13 (p. 28), was North American Aviation, Inc., which had been participating in both the interceptor and fighter-bomber competitions. Northrop also had entered in the interceptor competition. Republic Aviation was participating in the fighter-bomber project.

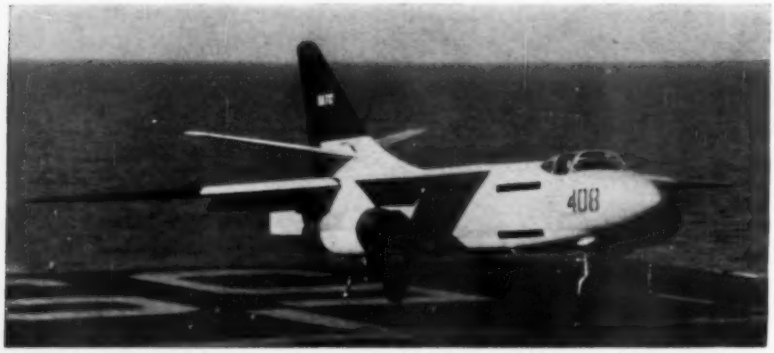
After the Air Force decision, announced to the affected aircraft firms in terse telegrams, Clifford C. Furnas, Assistant Secretary for Defense for Research and Development, indicated before a Senate Appropriations Subcommittee that the long-range interceptor probably was the most painless item to cull from R&D funds.

Preliminary studies, Furnas testified, showed that the interceptor would have excessive-weight characteristics. In addition, he said, a "higher-performance" project —probably a medium-range interceptor—already was under way.

Also, there was some doubt as to whether a long-range interceptor, with a 1,500-mi. combat radius, could fit into the present continental defense with its relatively short-range radar warning system.

Navy Tests Supersonic Fighters But New Aircraft won't be operational for quite a while. Chance Vought's F8U Crusader on catapult of USS Forrestal (above) shows the variable incidence wing in elevated position. One prototype crashed recently at Edwards AFB. The Grumman F11F on the deck edge elevator of the Forrestal (below) has its wing tips folded down, saving about two feet on each side for carrier deck handling.





DOUGLAS A3D lands aboard carrier Forrestal. NATC on tail shows model is being tested.

SAME TAIL markings are on FJ-4, also touching down on Forrestal in recent Atlantic cruise.

Development, gave full support to the administration program. He did cite, however, the Air Force's increased costs: "The development cost of the F-102 was more than twice that of the F-86, more or less its immediate predecessor, and the development cost of the B-52 more than two-and-a-half times that of the B-36." USAF's deputy chief for research and development, Lt. Gen. Donald Putt, has consistently made the point that, under the administration's "financially-level" program, the number of projects must consistently be reduced.

• **Frank D. Newberry,** Assistant Secretary of Defense for Engineering, outlined the Defense Department's energetic program to narrow the number of projects in advanced development and testing stages. The policy, he said, is "great competition in research and early design phases . . . but in the expensive development stages a choice should be made as soon as possible of one weapon for one purpose."

In their appearance before the subcommittee, Navy spokesmen stressed the mobility, comparative invulnerability and striking power of carrier aviation.

"In the day of ballistic missiles," Secretary of the Navy Charles Thomas testified, "carriers will not be targets for long-range missiles, which must necessarily follow a fixed trajectory."

Naval Chief Burke declared: "The mobility of naval forces assures that naval air striking power of the kind that is needed will be at the place it is needed when it is needed. Naval carrier based air is a powerful, useful augmentation of the long-range, shore-based air of our sister service, the Air Force."

Twining's View

Apparently provoked by the testimony of Thomas and Burke, Twining presented a statement on his view:

"In a war with the Soviet Union, the air battle job would consist of two missions: first, defense against the Soviet air attack, and, second, retaliatory attack upon the Soviet Union, especially the bases for its long-range aircraft. . . ."

Pointing out that the Navy would have heavy air defense and other missions to perform in a major war, Twining continued:

"The portion of the attack capability available to supplement the Strategic Air Command depends upon what priority naval tasks may exist at the time. The targets that can be attacked by such carrier-based planes as are available also depend upon the location of the carriers at the time in relation to the combat radius of their attack aircraft. The range of the carrier aircraft is relatively short compared with their land-based counterpart.

"But we must be realistic about such factors as the probable location of the carriers, as well as the amount of striking power they could contribute to the strategic air offensive, which is small."

Challenging USAF's Talos program; Taylor declared:

"The Talos has characteristics very similar to Nike: It is not the interceptor type that will range out and meet the incoming aircraft. . . . It is the Army role to defend 'point' targets such as air bases." He added that "both as to altitude and as to speed, there is no Russian bomber in existence or which we have heard about, that the present Nike is not able to bat down."

Sen. John Stennis (D.-Miss.), a member of the Appropriations Committee and also chairman of an armed service subcommittee considering new installations for air defense missiles, told Taylor the Nike has "limitations" and that it is "not fair to leave the impression that it is an absolute defense from a possible bomber attack." Stennis said the Talos is not as expensive as the Nike, has more range and would require less operational manpower.

Comparable to Talos

Gen. Taylor, on the other hand, said the Nike B, successor to the Nike II, will be comparable to the Talos and is at a comparable developmental stage.

In providing for air-atomic capability three to five years hence, Secretary Quarles testified that "we should err on the side of too much, rather than too little" but said he supported the administration's "sound, a tough austere, budget."

Quarles said that funds provided "will sufficiently support research and development." He pointed out, however, that "a number" of research and development projects approved by the air staff are not provided for. "Some of them are considered to have a high priority and are thoroughly justified."

Quarles noted that his endorsement of the Fiscal 1957 budget was subject to change: "Any unforeseen scientific breakthroughs, either on our part or by the Soviets, or any change in the world political situation, might, of course, change the picture materially."

In its efforts to cut back the number of projects in the "expensive" late development stages, Assistant Secretary Newberry reported that four yardsticks are applied:

• **Whether the project duplicates** any existing weapon or planned development;

• **Whether the project provides** a worthwhile improvement in performance;

• **Whether the project** has been adequately coordinated with the other military services;

• **Whether the planned release** date for quantity production of a new weapon or equipment is realistic in terms of its technical development status and degree of formal approval for service use.

Universities Will Evaluate Weapons

By Evert Clark

Washington—The Defense Department's Weapon Systems Evaluation Group has radically changed both the scope and method of its operations.

After seven years of failing to accomplish its missions because of a lack of qualified scientific personnel, the nation's highest-level evaluations group is now contracting most of its work to a corporation of universities headed by the Massachusetts Institute of Technology.

It has asked Congress for $2.4 billion for such contract work for Fiscal 1957. By contrast, WSEG spent only $25,000 in Fiscal 1955 and $80,000 in Fiscal 1956 for evaluations work done on contract.

The contract method was first suggested in the spring of 1953 by the Rockefeller Committee in its review of the Defense Department. Later an *ad hoc* advisory committee headed by Dr. James Killian, MIT president, "reluctantly" recommended the contract plan as the best solution to the evaluation group's dilemma.

Corporation's Task

The Joint Chiefs of Staff, the Assistant Secretary of Defense for Research and Development and the Secretary of Defense have endorsed the plan.

Last fall, contract arrangements were completed with MIT to establish the corporation. MIT, in turn, was to go ahead with evaluations work pending formal organization of the corporation.

Defense officials told a House Appropriations Subcommittee in testimony released recently that the California Institute of Technology, Stanford University, Case Institute and Tulane University "have indicated they will join this corporation."

Dr. Albert G. Hill, an MIT professor of physics and former Lincoln Laboratory head, has been hired as research director for two years at a salary of $22,000 annually.

The corporation will provide WSEG with 100 "professional employes"—scientists, engineers, etc.—recruited primarily from the universities. When the subcommittee heard the testimony last February, WSEG had only 24 staff members plus eight others "borrowed" from other analysis groups. Contract groups doing weapons and operations analysis for the Army, Navy and Air Force employ from 50 to 500 personnel.

The evaluations group was established in 1948 by the late Secretary of Defense James Forrestal to furnish his office, the Joint Chiefs and the old Research and Development Board with "an independent and objective analysis of present and future weapons. . . ."

The group is now under the Assistant Secretary of Defense for Research and Development for administrative purposes, but it does 90% of its work for the Joint Chiefs.

Lt. Gen. Samuel E. Anderson, WSEG director, told the subcommittee that the group "never has been large enough to accomplish the work assigned to it in timely fashion."

He said Adm. Arthur W. Radford, chairman of the Joint Chiefs, recently told Dr. Hill that WSEG had done good work with its small staff in the past, but "it took so many man-months to do the work that the answers usually got to the Chiefs of Staff too late to aid in their decisions. . . ."

Money—or rather a lack of it—was cited as the reason why WSEG had tried unsuccessfully for seven years to recruit an adequate staff:

• **J. R. Loftis**, director of Defense's Office of Administrative services, testified that "the contract method (is) the only alternative for making the WSEG effective enough to accomplish its mission."

"In this particular field," he said, ". . . there is terrific competition for the few men who are qualified for these operations analysis studies."

• **Gen. Anderson testified:** "Dr. Hill is taking a considerable loss in salary. . . . Everyone who has ever come into it has taken a considerable loss. . . . The competition in this field is really terrific. If the man is not motivated by patriotism you are not going to get him for the kind of money we can afford to pay him."

Subcommittee Concern

Subcommittee members showed some concern over:

• **Legality of entering** into a contract for most of the WSEG's work. Mr. Loftis and Gen. Anderson testified that the plan had been cleared with the Comptroller General for legality and discussed with government operations and military affairs committees in both the Senate and the House before arrangements were made with MIT.

• **Taking scientists away** from other defense work. On this point, Gen. Anderson said the universities will "make certain people available to this contract operation for a period of two or three years. This is going to be our principal source of personnel.

"We would expect that the people we get from the universities on loan under the contract would either not have been engaged in defense work, or if engaged, are in defense work of a kind which, relatively speaking, is better populated with talent than is the systems evaluation field. . . .

"Those people represent a significant addition to this limited field and not merely a transfer from one type of defense work to another."

Dr. Killian "wanted the cooperative effort as a means of broadening the base . . . to share the blame of taking these people from purely educational work for a while into defense work," Gen. Anderson said.

MIT's Position

Rep. Errett P. Scrivner (R.-Kan.) said he would like to see someday "a complete compilation of all of the defense contract work which MIT is doing and the number of people engaged in that work and then ascertain how much is left to carry on the regular activities of the school."

"Might I say, sir," Gen. Anderson replied, "that a group of educators recommended this method of improving the capabilities of WSEG but recommended it reluctantly. . . . (They) were most reluctant to do it but they felt they had to."

Dr. Killian's committee, chosen by him at the request of then Assistant R&D Secretary Donald A. Quarles, included Dr. Keith Glennan, president of Case Institute; Dr. Bright Wilson, chairman of Harvard University's Chemistry Department; Dr. Detlev Bronk, president of the National Science Foundation, and James Perkins, vice president of the Carnegie Corp.

The corporation's assignment is "to provide the personnel, facilities and materials required for surveys and analyses of the effectiveness of various weapons systems; evaluation of new equipment in the light of military requirements; evaluation and analyses of military problems to predict the operational behavior of new material and equipment; development of new tactical doctrines to meet changing military requirements; studies and reports on the technical aspects of strategic planning; and analysis of actual combat reports, tactical and strategic plans, and field exercises in both the continental U.S. and elsewhere, with a view to determining how existing weapons and weapon systems could be more effectively employed."

Testimony also revealed that the WSEG now is making studies of the limited war concept and an evaluation of last winter's continental defense exercise known as "Crackerjack."

In the future it hopes to make "a cost evaluation of all of our missiles from 350-mile range to 5,500-nautical-mile range," Gen. Anderson said.

USAF Report on Soviet Airmen Shows High Pay, 'Exalted' Status

Washington—The Soviet military man generally enjoys a more exalted position within his own society than the U. S. military man, and Russian air force pilots and technicians fare even better than their Red Army counterparts.

A U. S. Air Force study concludes that, contrary to conditions within the U.S., it is no sacrifice to belong to the service in Soviet Russia, particularly to the air force. Some of the reasons:

• **"In the Soviet air force** the member occupies a relatively high social status. . . . Pay, housing, food, clothing, medical care and prestige are equal to or above that enjoyed by the ordinary citizen of similar experience and training in civil life. Special privileges enhance purchasing power.

• **"Military life is made more popular** by the fact that a man receives pay commensurate with the importance of his job, regardless of rank. Long service affords substantial security for future life.

• **"The Soviet recognizes** the technician within the military structure as an important person. He is paid on the same relative basis as the technician employed in industry.

• **"Serving the state** in a military status is considered to be an honor, and the military man enjoys privileges not accorded to civilians. Consequently, there is little incentive for military personnel to seek civilian employment."

In this country, the rapid flow of military-trained technicians from the services into better-paying civilian jobs is receiving great attention from the White House, the Pentagon and Congress.

Re-enlistment rates for technicians run well below those for nonskilled soldiers.

Standard of Living

The Air Force study is based upon the limited information available from behind the Iron Curtain. It points out that comparisons are "extremely difficult" because of "the differences between the economic system of a totalitarian state and the free enterprise system," the rate of exchange between rubles and dollars, and the even more realistic relation of pay to prices and standard of living.

The study concedes that "the standard of living of the U. S. Air Force or Army member is undoubtedly higher" than that of the Russian soldier—but relatively speaking, the Russian stands higher in his society.

Russia's treatment of the pilot and the technician are particularly interesting.

In the Soviet air force, pilots and "shturmen" (bombardier-navigators) are the only rated personnel who receive flight pay. For longevity purposes, they receive double credit for time on flying status since 1948. For retirement purposes, they receive double-time credit for all periods on flying status.

Regular pay for pilots and shturmen is broken into three categories, based on experience and training proficiency. In addition they receive flight pay and pay for "required practice parachute jumps." Extra flying pay is awarded for every hour over the norm—the highest for night flying, the next for instrument, and the lowest for formation time.

Up to 40 parachute jumps pays 25 rubles (approximately $6.25) per jump. From 40 to 250 jumps pays 50 rubles per jump, and above 250 pays 100 rubles per jump.

Maintenance Challenge

Russia obviously has the same problems that plague the U. S. Air Force in technical areas, but the study indicates that the USSR has done more about it.

Every job carries a rate of pay based upon the assignment. This applies to enlisted men as well as to officers.

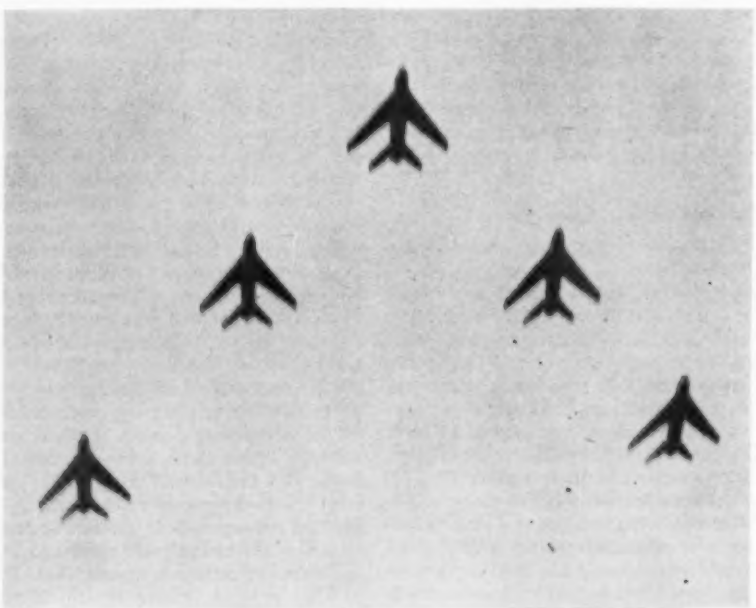
"Assignment pay reflects Soviet respect and recognition for technical ability," the study says. "Included in the technically trained category are such personnel as aircrew members, engine and airframe mechanics, electricians, and armament specialists, communications specialists and radar personnel.

"Aircraft mechanics reportedly receive 500 rubles per month irrespective of rank. All personnel above the grade of junior sergeant receive special allowances while serving outside the USSR."

Mechanics and radio mechanics receive monetary awards for engines and radios which function without breakdown for specified periods of time. In World War II, the study says, Russia paid bonuses of 1,000 rubles for each fighter aircraft downed and 500 rubles for each bomber. Ground attack and bomber pilots were paid a bonus for each mission.

Isolation Pay

"Assignment and incentive pay does not exist in the U. S. Air Force," the report points out. It also says USAF "does not provide monetary awards for special achievement. Personnel receive pay for their grade, without special consideration for relative efficiency or productivity." It notes parenthetically that the USAF has presented a "technician pay" proposal to the Defense



Farmer in May Day Flyover

Five Farmers fly over Red Square during the May Day celebration at Moscow. Though military display was reportedly cut down sharply, the flyover significantly did include the latest Soviet aircraft. Farmer, capable of supersonic speed, is believed to use two jet engines and has 60 deg. swept back wing and a low-set slab tail.

Department for consideration.

Isolation pay (for service in distant areas) may be paid to Russian officers at the rate of two months for one served, or one-and-a-half for one, depending upon the degree of isolation. Enlisted men draw isolation pay at the rate of two for one or four for one. (The study notes that the Defense Department is now studying a USAF proposal for "remote and isolated duty pay.")

Army officers and career enlisted men in Russia "are accorded a high degree of respect . . . but apparently not the same degree as accorded the Air Force flying member on flying status," the report said. "In general assignment pay is lower for Army personnel although base pay and longevity are similar."

In wartime, some military and naval units are designated "guard units" as a citation for meritorious service. This entitles officers to an extra 50% assignment pay and enlisted men to an extra 100%.

The study includes a comparison of benefits, using a hypothetical Soviet major who is a Class 1 pilot and squadron leader with 12 years service, and a USAF major with similar responsibility and service.

It shows that the USAF major draws higher base pay and longevity ($499.20 a month as compared with $345) and higher quarters allowance and flight pay. But he has:

- **No assignment pay.** The Red major draws $575 a month.
- **No meritorious unit pay.** The Soviet major draws $287.50.
- **No additional longevity** or retirement credit for his flight status.
- **No isolation pay,** no isolation credit for retirement, no extra flight pay above the minimum, no free tobacco ration, no uniform allowance, no family burial benefits, no housing furnished after retirement and half as much leave.

To add insult to injury, USAF officers and enlisted men pay income tax while Soviet enlisted men are exempt from income tax as such and officers receive certain special considerations.

Northrop to Build Supersonic Trainer

Washington—Northrop Aircraft, Inc., has been awarded a contract by the Air Force for a supersonic jet trainer. For the first time, the Air Force said, it would have a "pure" jet trainer with performance matching characteristics of operational aircraft.

Whitley C. Collins, Northrop president, said the award culminated two years of engineering effort by Northrop with its own funds. Northrop plans to establish the project at its main plant in Hawthorne, Calif.

Russian Technical Threat Dawns Slowly on U. S., Stever Warns

Dayton—The U. S. has been slow to recognize the fast-growing technological threat posed by the Soviet Union and is "just beginning to face up to the multiple task of maintaining current strength, of improving our strength for years ahead," Dr. H. Guyford Stever, USAF chief scientist, warned last week.

Despite earlier warnings such as an analysis by the New York Times published two years ago, Stever told the National Conference on Aeronautical Electronics, the nation has been reluctant to recognize that "Soviet technical education is good in training first-rate scientists and is turning out a larger number of engineers . . . than our schools."

The USSR is also challenging the U. S. in the "establishment of laboratories with the necessary complex equipment for research and development, and the utilization of the work of these laboratories in a concerted effort to make the Soviets supreme in the aeronautical world."

Stever cited four key factors which determine our capability to perform research and development:

- **Scientific manpower.**
- **Specialized facilities** for research and development.
- **Funding.**
- **Organization** and management.

Pointing out that an "aroused and informed public can help us improve our position in every one of these four factors," Stever expressed the opinion that "thinking people of the U. S. are now aroused to the necessity of doing something to strengthen our position in these four factors."

Public reaction and clamor for more funds and a more streamlined management of important programs, such as the long-range ballistic missile, have made themselves felt quickly. As proof, Stever cited recent statements by members of Congress that requests for research and development funds will be granted quickly wherever justified, and the recent centralization of missile program management.

However, Stever cautioned that "many years must elapse before a group of students (interested by public efforts) emerges as trained scientists and engineers, and their influence in the profession takes still longer to be felt. . ."

Facilities, which constitute one of the biggest bottlenecks in almost all of our large scale military development programs, take a long time to plan, design, construct, and put into service, Stever said. "A short time show of interest on the part of the public cannot greatly influence this."

Stever urged engineers and scientists to help inform other segments of our society of this need for long-term, continuing interest in the problems of scientific manpower and facilities. Stever contrasted the role of avionics today with its position 15 years ago, when it was considered merely as "auxiliary equipment." Today the avionics engineer has become a full partner, and his problems are treated on a par with those of propulsion, aerodynamics and structures, Stever said.

We have now arrived at a reasonable understanding of the problems of integrating electronics into aircraft and we can look forward to an era when avionics can make an even greater contribution to aircraft mission performance, Stever said.

Aircraft will make greater use of radar and infra-red in order to see aircraft and ground targets at greater distance, in good weather or foul, day or night, Stever predicted. Computers will take over more and more chores, because of greater aircraft speeds and increased mission complexity.

Speaking of ground-based avionics, especially for air traffic control, Stever said the principal problems facing engineers are "systems engineering problems." He added that in many cases, "political difficulties are as great as the technical."

Douglas DC-9 Design Will Use J79 or J52

Santa Monica—The DC-9, medium-range turbojet airliner being offered to the airlines by Douglas Aircraft Co., will be built around either the General Electric J79 engine or the Pratt & Whitney J52 engine.

The J79 is a 12,000-lb. thrust engine that is being used in the Lockheed F-104A Starfighter. The J52 was developed originally as a Navy engine with a thrust in the 7,500-lb. class.

Firm specifications of the DC-9 are not yet ready. Outline proposals only have been presented to the airlines.

It is believed that the DC-9 is at least slightly behind the Convair Skylark 600 in design development. The DC-9 is being offered as a competitive proposal to the Skylark.

The Skylark (AW April 9, p. 99) is designed to use the J79 engine and would carry 80 first class or 99 coach passengers on flights up to 2,000 mi. cruising speed would be 609 mph.

H. M. HORNER

W. P. GWINN

L. S. HOBBS

Horner Named UAC Chairman

East Hartford, Conn.—United Aircraft Corp. moved its top leadership up a notch last week to fill the gap left by the death of its chairman, Frederick B. Rentschler, on April 25 (AW April 30, p. 32). Among the promotions made by the UAC board of directors:

• **H. M. Horner,** 52, elected chairman and chief executive officer of the corporation to succeed Rentschler, who had held the post from the organization of UAC until his death. Horner has spent his entire business career with UAC and its divisions, joining the Pratt & Whitney Aircraft division in 1926 and becoming general manager in 1940. He has been president of United Aircraft Corp. since 1943.

• **Leonard S. Hobbs,** 59, elected vice-chairman with the responsibility for directing the corporation's engineering-and-research program. Hobbs won the Collier Trophy in 1953 for his conception of the Pratt & Whitney J57 split-compressor turbojet that now powers most of the supersonic fighters and heavy jet bombers of the Air Force and Navy. He has been associated with UAC since 1927, when he joined the Pratt & Whitney Division, and has been engineering vice president of UAC since 1944.

• **William P. Gwinn,** 48, elected president and chief administrative officer of United Aircraft Corp. and a member of the board of directors and its executive committee. Gwinn has been with the Pratt & Whitney Division for 25 years, advancing from stock clerk to general manager. While general manager of P&WA, he directed that division's transition from the piston to turbojet engine era and guided its entry into developing nuclear powerplants for aircraft.

• **Wright A. Parkins,** 58, named general manager of the Pratt & Whitney Aircraft Division. Parkins has been with P&WA since 1928 after earlier service with the Army Air Corps at McCook Field. Parkins has been engineering manager of P&WA since 1944.

• **Arthur E. Smith,** 44, succeeds Parkins as engineering manager of P&WA where he was formerly assistant engineering manager.

United's Profits Grow

United Aircraft Corp. last week reported a net income of $8,701,683 ($1.73 per share of common stock) for the quarter ending March 31, an increase of approximately $1.7 million over the figure for the same period of 1955.

Shipments during the quarter by United and its domestic subsidiaries totaled $215,282,597 as compared with $184,863,955 for the first quarter of 1955. Contracts, orders and government Letters of Intent as of March 31 was approximately $1,850,000,000.

Republic Organizes Fundamental Research

Farmingdale, N. Y.—A move toward more fundamental research is signified in the organization by Republic Aircraft Corp. of a scientific research staff. Newspaper advertising to attract qualified candidates was begun last week. Screening of the Republic staff started previously.

The announcement by Mundy I. Peale, president, said that the staff will work in the range between pure theoretical research and applied engineering. Thermal barrier, atomic energy applications and hypersonic flight will be among specific problems the unit will investigate, but it also will explore developments in mathematics, general physics, supersonics and nuclear physics.

Dr. Theodore Theodorsen, director of scientific research at Republic will head the staff, which will report directly to Alexander Kartveli, chief engineer and vice-president. The staff will be maintained on a semi-academic status. It will keep in close touch with governmental and industrial research institutes, including the atomic agencies. Much of this exploration will be to prepare for entry by the company into new fields affecting modern aeronautics.

Ford Starts Missile Research Subsidiary

Los Angeles—Ford Motor Co. has formed a subsidiary, Aeronutronics Systems, Inc., to encompass a broad field of scientific and technological operations ranging from guided missile systems to possible exploration of space.

Both the Los Angeles and the San Francisco areas are under consideration for location of the new company, which will be built around top scientific personnel who left Lockheed Aircraft Corporation's Missile Systems Division last year. The scientists quit because of a policy disagreement (AW Dec. 19, p. 16) and formed Systems Research Corp. in Van Nuys, Calif. for research and development of weapon systems. SRC will become one of Aeronutronic's facilities temporarily.

Ford's initial commitment for Aeronutronic will be $10 million, all of which will go for research and development facilities. Additional funds beyond this sum will round out a program of approximately $14 million.

Construction is expected to start by the end of the year and be completed in 1958. Between 1,000 and 2,000 persons will be employed.

Gerald J. Lynch is resigning as director of Ford's Office of Defense Products and Government Relations to become president of Aeronutronics. Lynch said:

"We expect to take a missile or other project and see it through from its very conception to its manufacture, and possibly even to its utilization and maintenance.

"When the new corporation gets to the point where it is ready to start production, it will either build new plants or use some of the modern, highly versatile facilities which Ford Motor Co. has located strategically in all parts of the country."

Occupying key positions are:

• **Dr. Ernst H. Krause,** former president and chairman of Systems Research Corp., who becomes Aeronutronic's vice president—research and development.

• **Dr. Montgomery H. Johnson,** former director of SRC's Physics and Nucleonics Division, appointed director of research and development.

• **Dr. Joseph V. Charyk,** SRC's former vice president, head of Aerodynamics and Propulsion Division.

Berlin Wins Vertol Board, 10 to 3, In Contest with Frank Piasecki

Morton, Pa.—Vertol Aircraft Corp. stockholders, in an acrimonious meeting touched off by former chairman Frank N. Piasecki, have elected a board of 13 directors, 10 of them representing the present management and three standing for the new Piasecki Aircraft Corp.

Piasecki, James J. Davis, Jr., and Donald N. Meyers, all officers of the new firm, no longer qualify for the Vertol board under a new by-law prohibiting representation by employes of a competing company.

Action on the new board was taken at the meeting attended by more than 200 stockholders. During the session, Piasecki and Davis, who serves as his attorney, frequently challenged Don R. Berlin, President of Vertol, on both his conduct of the meeting and his management of the company.

Piasecki accused Berlin of giving untrue answers to some of the 21 questions he had posed in a Philadelphia newspaper advertisement (AW May 7, p. 31). One of these was the issue of Berlin's alleged "borrowing" from Vertol. The president and new board chairman in 1953 had approved a stock purchase plan for Berlin involving cash and secured notes.

It was disclosed that Berlin had signed notes totaling $163,881 and still owes more than $91,000. He has paid off more than $72,000, a rate far in excess of the agreed reimbursement. Vertol's treasurer reported that he holds collateral to more than cover the remaining debt. Piasecki dropped the issue when these figures were announced.

Progress Report

In his report to the stockholders, Berlin emphasized these points:

- **Vertol expects the military** to renew its interest in the turbine-powered H-16 and will use its own money to continue some phases of the development.
- **Production of the H-21** helicopter is ahead of schedule.
- **Vertol has a $20 million contract** with France and has delivered the first six H-21's to the French ahead of schedule. At least some of the helicopters are scheduled for Morocco.
- **Vertol earnings** set a new high record of $1,551,000 in 1955, and figures for the first quarter of 1956 are substantially above those for the same period of last year.
- **The company expects a new contract** for a twin-turbine powered H-21 and a new VTOL-type aircraft.
- **Vertol's decision** to place increased emphasis on research and development and preliminary design is making progress.

Board Election

In addition to Berlin, who was re-elected chairman, the following board members were elected:

Lee L. Douglas, A. Felix du Pont, Jr., Thomas K. Finletter, John F. Floberg, Wesley R. Frysztacki, Harry S. Pack, John M. Schaffer, T. F. Walkowicz, Harper Woodward, Mrs. Grace M. Burns, Louis M. Cohen and Henry A. Hoffman. The latter three represent Piasecki Aircraft Corp.

In the voting, the management slate received support of 325,658 shares or more than 72% of the 449,618 voted at the meeting. About 3.8%, or 17,878 shares, were voted with the 105,797 shares owned by Piasecki Aircraft Corp., and listed as the principal asset of that corporation.

Alfred Spear, a Providence, R. I., jewelry manufacturer, was nominated by an independent committee and won the support of 285 shares.

Vertol Receives VTO Contract

Washington—The Army last week announced the award of a design-and-development contract to Vertol Aircraft Corp. for a turbine-powered vertical take-off-and-landing aircraft embodying the "high-speed performance of today's transport airplane."

The $850,000 contract, awarded by the Office of Naval Research for the Army, envisions a tilt-wing design equipped with a single turboprop engine geared to two rotor propellers mounted on the wing tips.

In its development, Vertol said it will utilize the flying-test-bed approach to explore the characteristics of a tilt-wing VTOL "with a relatively inexpensive aircraft in a matter of months rather than years required to design and construct a costly prototype."

The Vertol announcement of the contract also indicated that the company hopes eventually to broaden the applications of the aircraft to include the civil field.

Its research, the company said, "Will . . . benefit civil transport-type aircraft for local service operation utilizing heliports in city centers."

As in the Bell convertiplane and the Hiller concept for a vertical-wing design (AW Apr. 19, p. 56), Vertol's planned tiltable wing will swing to the vertical for take-off and landing and then back to the conventional horizontal position for normal flight.

VERTICAL rising aircraft projected for Army by Vertol Aircraft Corp., as drawn by artist. Design envisions rotor propellers near each wing tip.

Defense Wants Small Businesses To Have Fair Share of Contracts

New York—The Department of Defense is continuing its drive to give small business a fair share of defense work. Representatives of Defense, Congress and one large company—the Sperry Gyroscope Co., a division of the Sperry Rand Corp., made that clear at a conference here of small business specialists from the Army, Navy and Air Force.

The director for small business in the Department of Defense, John Hamlin, said small plant participation in the defense program is increasing slowly, but he would like to see more of it.

Some Shudder

In Fiscal 1951 small business received 19.1% of prime defense contracts, in Fiscal 1956 20.2%. This increase represents $150 million a year in defense work. Hamlin said this rate is about the same for subcontracts.

Rep. Abraham J. Multer (D.-N.Y.), a member of the House Small Business Committee, told the conference one drawback is that many small operators never have done any government business and shudder at doing any. "They still have an aversion to it," he said. "Many a Mr. Small Businessman shivers outside the door of the government procurement office like there's an ogre inside with horns on."

Hamlin suggested that small businessmen contact the Defense Department to qualify for the small business bidder's list.

Once on the list, the small operator may be solicited for bids on defense contracts. Even if he is not on the list, the small operator should go to the regional procurement office and check the bidding board. It is not necessary to be on the bidder's list to submit bids on contracts.

"Oddly enough," Hamlin said, "the small contractor can bid very successfully against big operators for certain type of work. When qualified as to capacity, I'd say the little guy gets the bid about 75% of the time. His costs are lower and he's more flexible."

Wider distribution of defense contracts to small operators seems desirable to Hamlin for better dispersal in case of atomic attack.

Do Good Job

James Mattern, production planning manager of Sperry Gyroscope and the company small business liaison officer, agreed with Hamlin as to small operator efficiency. He said Sperry only recently retired a battery of 20 screw machines because the small business market could handle the work at lower cost.

Without small suppliers of components and assemblies, Mattern said, Sperry simply couldn't do the job.

"They constantly display ingenuity and maneuverability in supplying quality goods at the right time and the right price," he said. "Of our 4,365 suppliers, 3,216 or about 74%, are in the small business category."

Of $42.7 million let by Sperry in subcontracting, businesses of less than 500 employes received $12.4 million or about 30%. About $21.6 million went to 1,130 business of more than 500 employes and $8.7 million to affiliates.

News Digest

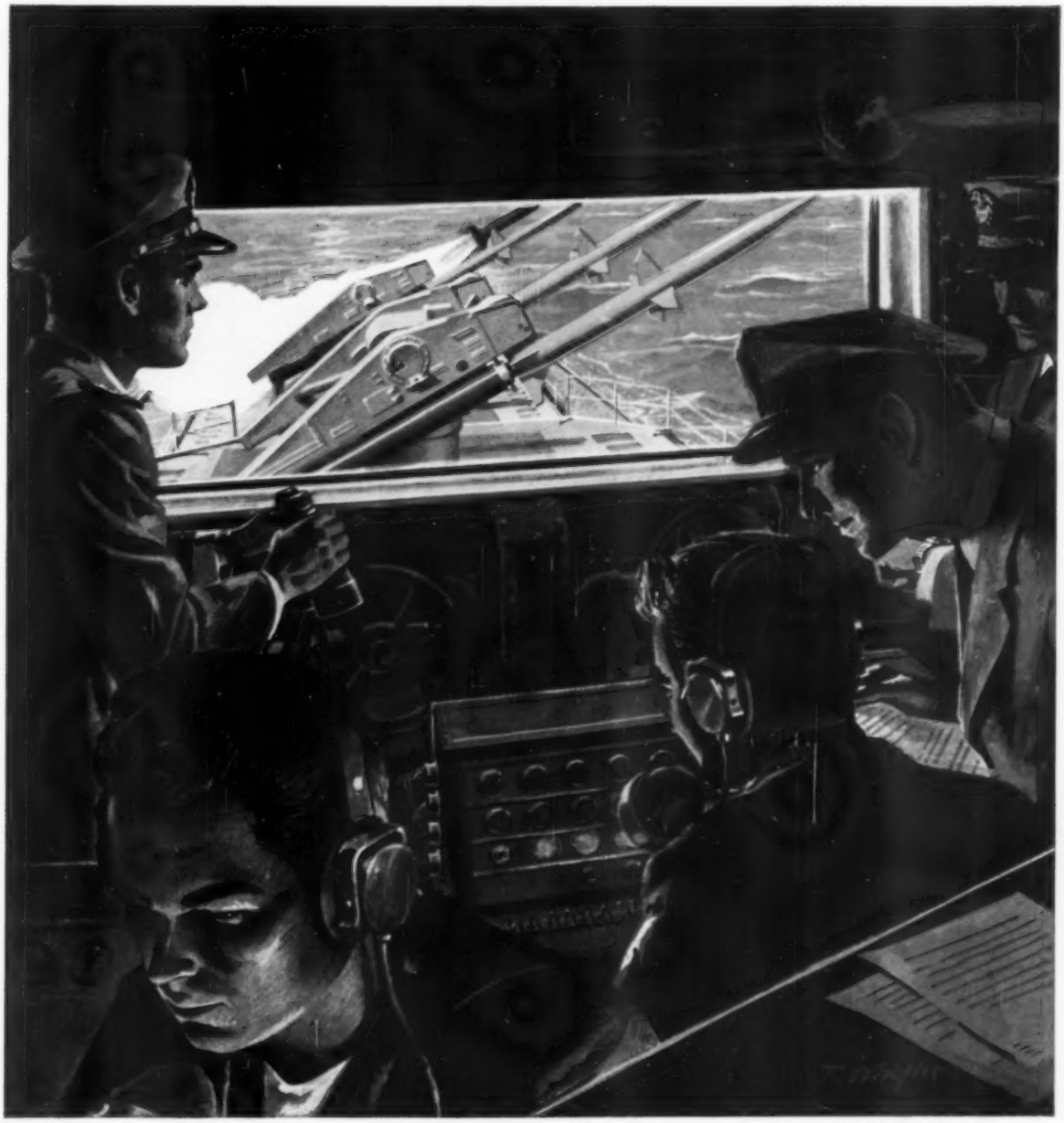
Navy's second guided missile submarine, Barbero, was scheduled to join the Atlantic Fleet at Norfolk, Va. Both Barbero and its predecessor, Tunny, are equipped to fire the Chance-Vought Regulus.

India's Defense Ministry says its decision to buy 40 Canberra jet bombers "is subject to the condition that they be fitted with some special equipment which meets the needs of the Indian Air Force." An Indian inspection team now in England may be influenced favorably by British Ministry of Supply decision to release the "blue study" radar bomb sight.

License to manufacture Lear gyroscopic system for indicating the attitude of an aircraft in flight has been granted to Officine Galileo di Milano, S.P.A., of Milan, Italy. Also included

Navy Guided-Missile Cruiser: USS Canberra

Navy's second guided-missile cruiser, the Canberra, is shown under way at the start of her sea trials. Commissioning is scheduled for June 15. Major change from the USS Boston, sister ship commissioned last year (AW Nov. 7, p. 14), is in the external appearance of the guidance radars mounted above and forward of the Terrier launchers. Major volume of firepower remains vested in the conventional gun batteries.



The Terrier...Navy Man's "Best Friend"

Just like its wiry namesake – the Navy's new anti-aircraft missile, the Terrier, has the built-in ability to track an aggressor. Once unleashed, no evasive maneuver can save invading aircraft from this obedience-trained supersonic watchdog.

Here is vast new protection for the Navy that protects you!

The Terrier is a significant example of the advanced weapons systems now being mass-produced for the defense of our country by Convair, working with the U.S. Navy Bureau of Ordnance.

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

Soon,
the newest product
of ORENDA'S experience
and imagination, a NEW
turbojet of great power,
will begin its
flight-testing
phase.
Wave patterns interpreted
from a wind tunnel photograph
of the ORENDA Arrow at
1800 miles an hour.
Institute of Aero Physics,
University of Toronto
ORENDA
ENGINES LIMITED
MALTON, CANADA
MEMBER A.V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

in agreement are manufacturing rights of Lear stability augmenter system.

Army awarded a $2.8 million contract to Beech Aircraft for L-23 Command Transports, military version of Beechcraft Twin-Bonanza executive airplane. Deliveries will begin in December and extend through May, 1957.

Convair personnel moving into Navy's Brown Auxiliary Air Station will return the XFY-1 Pogo to flight status. Plane was moved to Brown following factory overhaul.

Western Air Lines plans to sell $5 million in debentures as part of $48 million equipment financing program. Western also will borrow $6 million from a bank group headed by the Bank of America and $12 million from Prudential Insurance Co. of America. Balance of funds will come from net earnings, depreciation and proceeds from sale of surplus aircraft.

L. B. Smith Aircraft Corp. of Miami purchased sole ownership, manufacturing and sales rights to recently approved Transport Category approved C-46/W-20T. Plane was developed in conjunction with Air Carrier Engineering Services of Miami. It now is under evaluation by several airlines for use as replacement for DC-3, Smith announcement says.

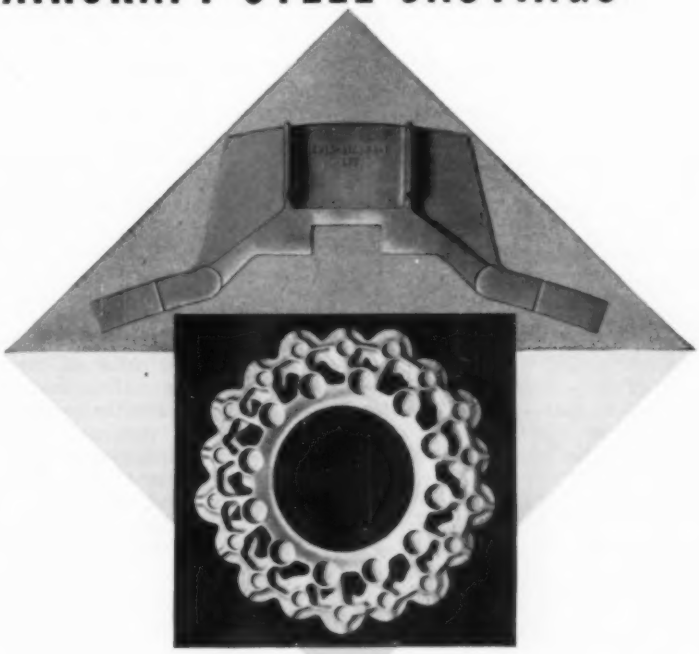
An international congress on rockets and guided missiles will be held in Paris Dec. 3 through 8. The Association Pour l'Encouragement a la Recherche Aeronautique is sponsoring the eight day discussion which they expect will include representatives from the United States, Great Britain, Germany and Italy.

USAF's Northern Air Materiel Area is expected to sign a contract with Fuji Heavy Industries Ltd. of Japan for 24 utility aircraft for the Japanese Ground Self-Defense Force. The Mutual Defense Assistance Program will pay $1.2 million for the aircraft, which is Fuji's modification of the U. S. Beechcraft Mentor.

Lockheed Aircraft Service increased basic salary rates 6% for some 400 employes. Hourly employes received increases ranging from 4 to 6%. Increases and benefits follow pattern of Southern California aircraft industry.

Lockheed Aircraft engineers received a 6% general increase in salary retroactive to April 9 and an additional 3% increase for next year. The contract terms were ratified recently by the Aircraft Chapter of the Engineers and Architects Assn.

LEBANON'S NEW CERAMICAST PROCESS NOW IN QUANTITY PRODUCTION OF TWO AIRCRAFT STEEL CASTINGS



...the BENDIX 149543. This backing plate for the Bendix disc-type aviation brake was previously fabricated in light alloy materials. When increased heat and stresses made it mandatory to change to steel, Lebanon was given the assignment. Backing plates were redesigned as cast steel parts and are now in quantity production at Lebanon.

...the CHANCE VOUGHT 15-510664-1. This support fitting for a jet engine removal track in the Chance Vought Crusader was originally produced as a machined part. When quantity production made this cost impractical, Lebanon's CERAMICAST Process was able to meet all requirements satisfactorily at a considerable cost saving. The desirable characteristics of the original machined part have been substantially retained.

...OUR SERVICE TO YOU. The aircraft industry is finding increasingly wider use for the CERAMICAST Process. We invite you to send us your blueprints or to visit our Plant in Lebanon. Our engineers will show you how CERAMICAST is adaptable to your project design.

WRITE FOR CERAMICAST LITERATURE: Bendix and Chance Vought Case Histories; CERAMICAST Technical Bulletins.

CIRCLE L

LEBANON STEEL FOUNDRY

63 LEHMAN STREET LEBANON, PENNSYLVANIA

CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

CAB Drafts Plans for Fare Investigation

Fare study, launched under congressional pressure, to be limited to general level of passenger fares.

By Craig Lewis

Washington—Bowing to growing congressional pressure, the Civil Aeronautics Board has launched a general investigation of the domestic trunk-airline passenger fare level.

The CAB has decided that substantial returns in the past six years, a relatively-stable load factor and a decline in unit costs are all factors which warrant a review of trunkline passenger fares.

The Air Transport Assn. is officially on record as neither opposing nor favoring an investigation. But privately the airlines aren't happy at the prospect of a prolonged examination of their fare structure.

Right now, the Board has decided tentatively to limit the investigation to a study of the general level of passenger fares and exclude such issues as the legitimacy of specific fares or fare classes and the relationships between them.

Rate of Return

This limitation would limit any decision of the investigation to flat percentage changes in the fares of any carrier or group of carriers. The CAB is now accepting criticisms on this limitation of issues and will hold oral argument next month on the scope of the case.

Commenting on a summary of airline returns, the CAB observed that the carriers have earned a return in excess of 10% in every year since 1950. The rates have ranged from a high of 14.6 in 1951 to a low of 10.4 in 1954. In the 1950-55 period, the average industry investment has grown from $330,673,000 to $603,566,000. Last year's rate of return, based on reported net profit, was 11.8%.

A summary of cumulative returns over five-year periods show a steady increase between 1950 and 1955. The rate of return for the five years ending in 1950 was 2.8%. This period included the 1946-48 years when the carriers were losing money. The return for the five years ending in 1955 was 12.3%.

The Board did a more detailed analysis of last year's results (see box). Starting with reported net profit, the CAB adjusted the carrier's figures for mail, retirement, depreciation and other charges and produced new returns which vary considerably from the original figures in a few cases.

The bulk of the adjustments came in the retirement and depreciation categories.

The capital gains from equipment sales were eliminated and depreciation charges were adjusted to bring them in line with a standard policy of a seven year service life and a 15% residual value.

In most cases, this technique produced change of about 1%, but it increased Eastern Air Lines rate of return from 13.4% to 20.5% and cut capital airlines' return from 21.6% to 4%.

Load-Factor Increase

The Board relates stability in load factors to these rates of return as further justification of an investigation. The CAB said that the trunklines apparently have "reasonably attainable and relatively-stable passenger load factors in the range of 63 to 65%.

According to CAB records, trunkline load factors have gone from 62.7% in 1950 to 64.1% last year. The cycle includes a peak of 69.6% in 1951, then tapers down from 67.1% in 1952 to 64.7% in 1953 and 63.4% in 1954.

A declining trend in airline unit costs is cited by the Board as a third reason for looking into the fare situation. The CAB decision said that, despite inflationary pressures, unit costs have steadily declined.

In the past ten years, according to the Board, costs per available ton-mile have gone from 32.3 cents in 1946 to 26.1 cents in 1955. Cost per revenue ton-mile climbed from 49.7 cents in 1946 to 59 cents in 1948 and has moved down to 46.9 cents in 1955.

"It further appears," the CAB said, "that over the past ten years there has been a consistent and substantial growth of traffic which is still continuing and which further supports an assumption that load factors no lower than those enjoyed in the past three years should continue."

Why Investigation Limits

In limiting the issues involved in the investigation, the Board said the move was essential in order to reach a prompt decision in the case. The present opinion is that the issue should not go beyond the general across-the-board fare level and should not contemplate anything but a general change in levels.

At the same time, the Board makes it clear that such a limitation would not keep it from deciding at the end of the investigation whether any fare changes should apply to all carriers or to just a few of them. The CAB also would be free to apply a uniform change to all carriers or order different changes among the carriers.

The position of the ATA is that the CAB's fare probe isn't worth the trouble. ATA says the airlines aren't afraid of an investigation, but they feel the Board will wind up approving the present system of setting fares and will find the present fare levels reasonable.

The airlines don't favor the idea of a general cut in fares as a practical matter, but they also have some other reservations about the possible effects of the CAB investigation. They feel that the mere existence of a fare review lends enough uncertainty to future earnings to take the shine off their newly established position as sound, attractive investments.

This fact is important right now to some airlines which are still struggling with the problems of financing their expensive new equipment programs. Some observers feel that uncertainty over future earnings will scare possible money sources away.

Any action the CAB might decide to

Trunk Airline Rate of Return For 1955

Carrier	Average Investment	Rate of Return
American	$137,753	11.1%
Eastern	102,362	20.5
TWA	68,718	9.6
United	141,605	9.0
Sub-Total	450,138	13.1
Braniff	20,051	10.1
Capital	19,831	1.0
Delta	33,631	11.9
National	25,732	15.6
Northwest	23,556	11.3
Western	15,228	15.1
Sub-Total	138,032	11.1
Total of Above	588,470	12.9
Colonial	1,748	−8.8
Continental	8,167	6.0
Northeast	5,181	2.3
Sub-Total	15,096	3.0
Total—All Trunks	603,566	12.7

take in establishing a more clearly defined, stricter policy on setting fare levels is also looked upon with disfavor by the carriers. They feel they still need considerable flexibility in experimenting with fares as a means of developing traffic. A strict set of rules on rate of return and other factors is viewed as a potentially hampering influence in traffic promotion.

Most of the pressure for a fare investigation has come from Congress. A focal point of these pressures has been the hearings held on the airlines and the CAB by the House Anti-Trust Subcommittee under Rep. Emanuel Celler (D.-N. Y.).

Equipment Investment

Testifying before the subcommittee, ATA Vice President Stanley Gewirtz pointed out that the airlines have reinvested 82% of their money in new equipment over the past ten years, a period in which airline stock values have risen only about 15% as much as the average for all industrial stocks.

In the last ten years, according to Gerwirtz, the airlines have put $1.4 billion back into new equipment and paid their stockholders $91 million. The $1.4 billion has come from $286 million in earnings, plus loans, stock sales, depreciation and equipment disposal.

A complicating factor in the airlines' plans for the future is the sharp upward trend in the cost of new equipment.

The unit prices of new aircraft have gone up substantially since World War II, and the move into the jet era has meant a big jump in cost, since the turbojet transports now being ordered are priced in the $5-$6 million class.

Nation Needs Civil Airports for Defense

Los Angeles—Commercial air terminals definitely are a part of overall American air power and the Strategic Air Command may well use them in any full-scale emergency, Gen. Curtis E. LeMay, SAC commander, told the Aero Club of Southern California last week.

LeMay joined with Gen. Carl A. Spaatz, Ret., first Air Force chief of staff, in urging approval of the Los Angeles Airport bond expansion program.

"Your plans for future development have a meaning to our national defense," LeMay said. "I cannot foresee a defense budget big enough to provide civil air installations to back up military needs. It is up to the cities, acting in their own interests, to protect their standings in the competitive air age. If war should come, the country will need these terminals, and can use only those which are ready."

In a few years we may be looking back on the jet age from the age of nuclear powered aircraft, LeMay predicted. The inevitable future progress of aviation points up the need for modern air terminals, the SAC commander said, and if our major cities do not prepare for this progress, either aviation will pass these cities by, or the progress of aviation itself will be delayed.

Gen. Spaatz told the group that Los Angeles should act now on an adequate airport to handle the airplanes which soon will be flying.

House Group Calls for Mail Probe

By L. L. Doty

Washington—After giving assurances that it would "keep a watchful eye" on developments of the Civil Aeronautics Board investigation of passenger fares (see p. 38), the House Anti-Trust Subcommittee last week readjusted its sights and pressed hard for a review of air mail rates.

The switch, following a CAB announcement that a fare investigation would be launched, brought protests from Stuart Tipton, president of the Air Transport Association, that a probe of air mail rates would be unjustified and a waste of time. Referring to a recommendation for such an investigation by the General Accounting Office, Tipton challenged the U. S. Comptroller General's conclusion that a study should be conducted to justify the difference between air mail and freight rates.

Other developments during recent sessions of the hearings which already have touched on almost every phase of airline operations were:

- **Charges the scheduled airline** industry has made attempts to corner military traffic through joint action.
- **Allegations that travel-agency** agreements with the various airlines are in violation of anti-trust laws.

The issues arose during testimony by ATA Vice President Stanley Gewirtz to show the growth of air transportation and to refute any suggestions of monopoly or concentration.

ATA Rebuttal

Tipton said it would be impractical to apply freight rates to air mail rates since freight traffic is geared to high volume and large shipments causing handling charges to be less. He pointed out that freight shipments average 195 pounds as opposed to a 13 pound average for air mail.

In addition, he continued, "The minimum freight charge is $4.00. If you apply freight tariffs to the mail we handle, actual ton-mile yield of freight is higher than our air mail rate per ton-mile by reason of minimum rates and differences in weight."

Tipton said the GAO is not "constituted as either a rate-making agency or as a group of rate-making experts." He added that he held a great respect for the present Comptroller General and his office but considered his rate-making principles "just plain wrong."

It has not been more than a year since the CAB re-set air mail rates for air carriers, he argued. In the course of that study, Tipton said, the relationship of air mail to air freight was thoroughly discussed. The subcommittee held firm to its belief, however, that an investigation should be instituted to reconcile the differences of opinion between the government and the airlines on the point of air mail rates.

Tourist-Agency Relations

On the subject of travel agents, Herb Maletz, subcommittee counsel, suggested that agency resolutions issued by scheduled airlines might have run afoul of anti-trust laws if CAB approval had not been granted.

Donald Markham, assistant general counsel for the ATA, said, however, that the airlines were not concerned with who travel agents represented as long as they were good agents. But, he insisted, the airlines were particular as to which agents they appointed to prevent every "shoeshine parlor, drug store and poolhall" from entering the business. No attempt, he said, has ever been made to prevent travel agents from serving supplemental carriers or any other transport organization.

The subcommittee also devoted considerable time to questions on the issuance of operating certificates to new carriers, and Gewirtz interrupted his own testimony to answer charges that petitions for domestic trunk-line certificates by 164 new carriers had been denied during the past ten years.

Gewirtz said that the total had been misinterpreted since there were not 164 "carriers" involved but 164 "applications" for routes with several companies presenting more than one petition.

Of the 164 applications, he said, only 15 were for domestic trunkline routes. These he said included a railroad, requests for feeder service, companies with unstable financial background, non-operating companies, one desiring a combination bus-air service at 3½ cents a mile, a tour service proposal and three applications by supplemental carriers.

Final Senate Approval of Lowen, Minetti Expected on Wednesday

Washington—Senate hearings on the nominations of Charles J. Lowen as Civil Aeronautics Administrator and F. Joseph Minetti as a Civil Aeronautics Board member drew to a close last week after three days of debate, much of it centered around CAA policies concerning segregated airport facilities. Final approval of the two candidates is expected Wednesday at an executive meeting of the Senate Commerce Committee.

The hearings were side-tracked by the segregation issue when a memorandum signed by Lowen April 6 was brought to the attention of the committee. The memorandum detailed an October 1955 directive which denied federal aid to sections of airport terminal buildings with segregation facilities.

Segregated-Airport Policy

Under questioning by South Carolina's interim Sen. Thomas A. Wofford, Lowen explained that the policy applied generally to various airport buildings and specifically to those areas which are designed for ai port use.

He said this order does "not make incligible for federal aid any airport which may in fact have segregated terminal facilities.

"The federal government will participate in the construction of runways and in all portions of the terminal building except those which are intended for segregated use."

The memorandum drew its first fire earlier this month when Rep. John Bell Williams (D.-Miss.) called for a reduction in Commerce appropriations to offset funds which could be denied certain states where segregation is enforced.

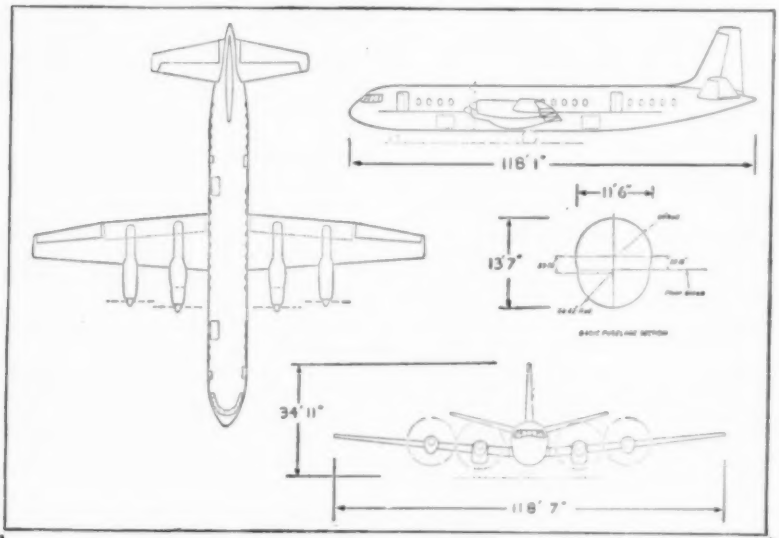
Lowen on Tacan

Lowen said the memorandum was issued in response to a large number of requests for clarification of the original order which was published in a "policies and procedures" booklet. He told the committee he had "no personal knowledge of the reasons underlying the policy's initial development."

During testimony on Tacan versus VOR/DME as a common military-civil navigation system Lowen assured the acting chairman, Sen. A. S. Mike Monroney (D.-Okla.) that he would not "rush haphazardly" into any navigation program until all facts had been thoroughly studied.

In response to other questions, he also told the committee he:

- **Knew of no plans** to reorganize the CAA.
- **Had not been pressed** to create new jobs.
- **Would closely abide** by Civil Service regulations.
- **Knew of no cases** where he had been by-passed by persons seeking airport concessions.



LATEST VANGUARD SPECIFICATIONS

DIMENSIONS AND AREAS

Gross Area, Main Plane	1,527 sq ft
Flap Area	161 sq. ft. per side
Aileron Area	61 sq. ft. per side
Tail Plane Area	450 sq. ft.
Elevator Area	146 sq. ft. total
Fin and Rudder Gross Area	308 sq. ft.
Rudder Area	88 sq. ft.
Total Cabin Volume	5,894 cu. ft.
Freight Hold Volume	1,430 cu. ft.

PAYLOAD AND WEIGHTS

Current Maximum Payload (Zero-Fuel)	23,000 lbs.
Designed Maximum Payload, Nominal	21,000 lbs.
Passenger Capacity, First Class	76
Passenger Capacity, European Tourist	93
Fuel Capacity	5,100 imp. gal. (6,125 U.S. gal.)
Cruising Speed (Maximum Landing Weight)	400 mph. increasing to 425 mph. between 1959 to 1963
Maximum Takeoff Weight	135,000 lbs.
Maximum Landing Weight	108,500 lbs.
Maximum Zero-Fuel Weight	98,500 lbs.

Airlines Go Underground In Dallas Fueling Design

Dallas—A million-dollar underground hydrant fuel system, designed to handle both piston and jet aircraft, will be installed at Love Field, Dallas under joint sponsorship of American Airlines, Braniff Airways, Continental Air Lines and Delta Air Lines. They are financing the project through a Dallas bank.

The system will deliver 300 gpm. to aircraft tanks through outlets located on the terminal ramp and connected by eight pipelines to 12 storage tanks with a 50,000-gallon capacity each. Allied Aviation Fueling Company of Dallas will operate the system.

Other airlines will be able to use the underground system. Vehicular traffic on ramps and around loading gates will be greatly reduced, and movements of trucks handling mail, cargo and luggage will be faster.

Hughes' Jet Plan Rekindles Old Debate

Washington—Howard Hughes has revived the question of just how closely an aircraft builder can become associated with its airline customers through a bid for Civil Aeronautics Board approval of a plan to build jet transports for Trans World Airlines.

Hughes wants CAB to alter the conditions of its long-standing approval of his control of TWA so Hughes Tool Co. can build jet transports and sell up to 25 of them to TWA. Under present conditions, transactions between the two companies are limited to $10,000 a year.

TWA told the CAB that it doesn't think presently proposed jets will have enough range for year-round nonstop operations across the Atlantic. The airline said that Hughes is willing to build a transport using the "most recent" design developments and to begin deliveries in 1961.

No official word is available on just what kind of aircraft Hughes would build or where he would build it, although he recently announced he would build new facilities in Florida.

Past Rulings

The Hughes-TWA petition reopens long-dormant questions of federal policy on the proper relationship between air carriers and aircraft manufacturers. The government decided in the 1930s that the two should operate in separate spheres, and the Civil Aeronautics Act of 1938 prohibited one from acquiring control of the other.

A prime example of this philosophy of separation was the government-dictated split of United Aircraft Corp. and United Air Lines in 1934. United Aircraft, which then included the Boeing Airplane Co., was forced to relinquish control of United Air Lines after a Senate investigation of airline mail rates.

The law, however, gives the CAB authority to approve acquisition of control providing it doesn't create a monopoly and restrain competition or harm another airline. It was under this authority that the Board approved Hughes' control of TWA (then Transcontinental and Western Air) in October, 1944.

Hughes started buying TWA stock in 1939, and the CAB found that he had acquired control of the airline toward the end of 1940 when he owned 42.1% of the common stock. CAB approval of the new control situation was requested.

The Board approved the deal with certain provisions. Transactions between the two companies, Hughes Tool Co. and TWA, were limited to $200 each and a total of $10,000 a year.

TWA also has to file annual reports detailing such transactions. Affiliates and subsidiaries of Hughes Tool Co. are included in the limitation which has been modified to a minor degree a few times in the past 12 years.

In approving the deal, the CAB noted that, while Hughes was building military aircraft parts during World War II, the company had no future plans to produce aircraft, parts or facilities for commercial use. Since then, Hughes has gone into various aircraft activities, including electronic and guided missile work.

Hughes' Airframe Background

Hughes' plan to build a jet transport isn't his first venture into the commercial transport field. He and Jack Frye, then president of TWA, collaborated on a four-engine transport design that eventually was manufactured as the Lockheed Constellation.

Other Hughes airframe projects haven't been as successful. His giant flying boat made only a token flight before it became a floating laboratory, and his giant helicopter, the Flying Crane, has never reached the production stage.

In its petition, TWA said:

"During the past few years important new developments have occurred affecting jet aircraft which make it possible to design aircraft at this time that are superior in performance, safety and economy to the commercial aircraft now being constructed, the designs for which were initially laid down four or five years ago."

Jets: Moscow to Delhi

New Delhi—India's Transport and Communications Ministry has been informed that the Russians are ready to put their Tu-104 twin-jet airliner on the Moscow-Delhi route this summer. One reason for putting the Tu-104 on this route is the possibility of selling it to the Indian Airlines Corp. The twin jet may also fly between Moscow and Peking, Cairo, Kabul and Djakarta.

In November, India completed arrangements to establish an air link with Moscow, via Zurich. It was then understood that Air-India International would fly Russia-bound passengers to Zurich where they would tranship to Prague by Swiss aircraft. Since then AII has extended a direct service to Prague and investigated a trans-Himalayan route direct to the Russian capital.

TWA, says Hughes, will build a jet transport which would take recent design developments into account and sell it on terms at least as favorable as those offered by manufacturers of similar aircraft.

The airline said it would use the transport on both domestic and international routes.

Hughes would sell the airplane to any airline that wanted one at the same price charged TWA. The carrier said the transport would be built by the Aircraft Division of Hughes Tool Co. "in a new factory to be located in accordance with the recently announced policy of the Air Force to insure the widest possible dispersal of aircraft production facilities."

TWA's complaint against presently planned long-range jet transports is that they don't have the range to operate nonstop in both directions under extreme weather conditions often met on Atlantic routes.

CAB Undecided

Defenders of the Boeing 707 and the DC-8 say the two transports do have the necessary capability. Douglas Aircraft Co. pointed out that the DC-8 has been ordered by airlines with long experience for use on their overseas routes and said that both Douglas and the airlines are satisfied the DC-8 will meet operating requirements.

Hughes has bought eight Boeing 707-120s for TWA and is reported to have ordered another 707-120 and 18 Boeing 707-320 intercontinental transports. He also is reported ready to buy 30 Convair Skylarks for TWA to use on its shorter routes.

The CAB is undecided as to how it will handle the Hughes-TWA petition. The Board can set up a formal hearing on it and develop a full record, or it can ask its general counsel for a legal opinion on the matter and decide the case without a lengthy public hearing.

Approval of the Hughes-TWA proposal would mean a switch in the policy on separation of aircraft builders and airlines. Control relationships between builders and carriers have been frowned upon in the past, although some precedent for approval of the TWA plan exists in the general field of interlocking relationships between airlines and people in various other phases of aeronautics.

If the Board decides to conduct a major review of its policy on the kind of control relationship proposed by Hughes and TWA, it probably will launch a public hearing. If this happens, a decision is several months away.

Ship fast

UNITED offers 300-mph DC-6A Cargoliner service coast to coast!

UNITED DC-6As offer the cargo protection and dependability of the only radar-equipped cargo flights!

UNITED'S Motorized Tug Bar speeds the loading of heavy parts, machinery!

Ship sure

UNITED DC-6As have greater tie-down strength than any other cargo plane!

UNITED DC-6As can accommodate tools, parts, engines up to 8000 lbs. each!

UNITED'S pre-loaded pallets protect delicate shipments from extra handling!

Ship United

UNITED'S Telemeter Airbill means faster pick-up at terminal points!

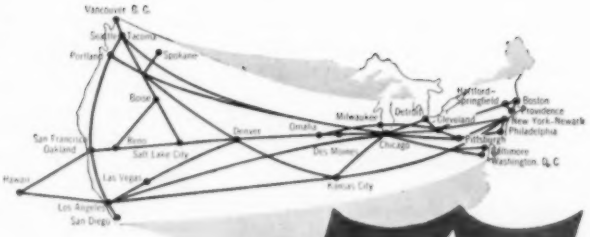
UNITED offers reserved Air Freight space on all equipment!

UNITED'S centralized payload control guarantees space dependability!

Examples of United's Low Air Freight rates—
*per 100 lbs.**

CHICAGO to CLEVELAND	$4.78
NEW YORK to DETROIT	$5.90
DENVER to OMAHA	$6.42
SEATTLE to LOS ANGELES	$9.80
PHILADELPHIA to PORTLAND	$24.15
SAN FRANCISCO to BOSTON	$27.00

*These are the rates for most commodities. They are often lower for larger shipments. Rates shown are for information only, are subject to change, and do not include the 3% federal tax on domestic shipments.



UNITED AIR LINES

For service or information, call the nearest United Air Lines Representative. Write for free Air Freight booklet, Cargo Sales Division, Dept. J-5, United Air Lines, 5959 S. Cicero Ave., Chicago 38.

Airline Traffic—First Quarter 1956

	Revenue Passengers	Revenue Passenger-Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	1,692,006	1,029,313	66.88	4,893,649	2,635,524	14,560,120	123,271,622	60.08
Braniff	434,552	165,673	61.41	536,474	334,964	881,222	17,616,549	54.27
Capital	593,872	188,398	58.98	741,403	516,009	822,765	20,083,844	44.28
Colonial	88,918	22,384	55.60	42,313	18,197	89,363	2,288,230	56.99
Continental	161,078	58,329	52.74	196,825	75,616	297,022	6,156,880	45.07
Delta	564,058	275,911	65.12	891,099	649,749	1,652,836	29,748,415	59.34
Eastern	1,830,766	1,046,853	65.24	2,823,887	1,251,405	3,392,174	116,443,567	52.20
National	410,531	315,199	71.56	978,668	222,308	1,474,496	34,948,874	71.07
Northeast	100,288	20,298	56.31	29,087	35,316	53,294	2,003,470	55.58
Northwest	289,157	180,148	57.74	1,076,392	632,122	1,623,938	21,347,848	51.51
Trans World	907,953	675,485	59.08	3,143,579	1,985,412	5,613,055	75,442,316	54.89
United	1,386,555	912,646	63.43	6,955,472	2,995,058	9,729,150	107,285,930	56.94
Western	45,632	22,884	63.74	98,951	32,249	63,302	2,378,925	57.54
INTERNATIONAL								
American	34,705	26,188	76.73	35,408	1,122	690,524	3,520,572	76.18
Braniff	8,041	16,882	42.63	80,071	.....	245,609	2,241,463	45.59
Caribbean Atlantic	51,337	4,030	59.77	3,463	.....	11,168	383,254	57.03
Colonial	4,599	3,561	41.93	1,758	.....	9,760	400,104	46.03
Delta	15,187	15,376	56.90	22,729	.....	188,556	1,784,832	47.32
Eastern	49,460	68,030	65.27	215,419	.....	209,741	7,826,493	58.84
National	35,719	21,994	72.05	26,740	11,001	66,059	2,388,417	77.00
Northwest	21,371	45,115	52.23	2,814,153	52,129	2,108,464	9,920,001	66.38
Pan American								
Alaska	13,349	17,268	59.98	83,815	.....	704,762	2,618,911	49.00
Atlantic	184,625	222,835	58.76	2,953,400	.....	5,609,517	32,052,521	59.81
Pacific	60,779	175,480	67.61	3,230,638	.....	3,637,657	25,547,516	65.89
Latin America	301,793	252,132	63.75	991,139	.....	9,142,767	35,359,796	61.91
Panagra	35,002	42,106	59.58	146,085	.....	1,007,214	5,636,906	59.22
Trans World	43,508	114,046	56.06	2,253,919	.....	2,153,932	16,656,849	65.78
United	19,368	48,249	65.96	311,003	.....	139,276	5,449,849	61.90
LOCAL SERVICE								
Allegheny	70,810	11,411	43.09	18,382	43,491	3,950	1,152,679	44.21
Bonanza	31,512	6,713	41.24	12,503	9,339	12,100	671,540	39.62
Central	24,055	4,170	30.89	10,401	7,207	14,298	430,387	27.89
Frontier	45,570	14,246	52.51	63,925	27,025	134,253	1,588,735	61.43
Lake Central	27,682	4,259	34.39	5,899	29,600	.....	431,461	33.33
Mohawk	68,889	12,310	54.69	11,519	19,387	23,946	1,228,322	54.57
North Central	110,504	16,481	50.62	52,986	79,318	.....	1,708,556	45.41
Ozark	65,826	9,872	34.05	24,075	42,709	.....	990,115	34.64
Piedmont	81,845	15,583	46.68	41,243	29,961	32,179	1,594,958	46.87
Southern	42,396	7,491	43.11	22,777	31,994	.....	771,861	40.99
Southwest	57,557	11,760	45.61	20,218	13,513	36,148	1,190,027	45.32
Trans Texas	46,126	10,475	38.28	35,089	22,287	49,227	1,105,384	35.35
West Coast	46,314	8,399	42.58	12,812	6,906	20,670	820,855	51.18
HAWAIIAN								
Hawaiian	83,657	11,638	56.04	11,588	.....	347,922	1,366,576	49.71
Trans Pacific	37,658	4,761	46.93	2,665	.....	21,447	395,843	47.85
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	1,905,792	1,905,792	62.20
Flying Tiger	10,649	34,123	96.23	75,599	.....	16,640,179	20,127,976	70.07
Slick	4,157	12,250	85.60	114,261	.....	15,759,661	17,098,910	76.84
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
HELICOPTER								
New York Airways	6,913	129	50.99	2,887	3,157	1,298	19,646	55.10
Los Angeles Airways*	.....	.....	.....	.....	.....	.....	.....	.....
Helicopter Air Service	.....	.....	.....	6,552	.....	.....	6,552	41.78
ALASKAN								
Alaskan Airlines	8,914	3,643	25.40	133,256	.....	890,513	1,439,015	40.97
Alaska Coastal	7,185	678	53.73	10,601	.....	10,274	89,771	61.90
Byers Airways*	.....	.....	.....	.....	.....	.....	.....	.....
Cordova	3,468	517	45.96	8,190	.....	128,849	195,275	72.22
Ellis Air Lines	8,606	424	49.35	5,155	.....	5,035	53,372	61.68
Northern Consolidated	3,332	934	43.24	58,329	581	925,713	1,086,710	87.85
Pacific Northern	4,977	895	39.10	40,892	.....	49,049	180,208	54.27
Reeve Aleutian	474	308	31.92	33,358	.....	36,195	103,660	57.78
Wien Alaska	4,923	2,054	16.39	81,599	.....	1,988,631	2,279,118	92.06

*Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Her name means "luxury" in many languages

Moving smoothly down the runway—this twin-decked Boeing Stratocruiser is about to take off on another routine over-ocean crossing.

For seven years Stratocruisers have spanned the U. S. and linked four continents. They have made more than 30,000 over-ocean crossings. They have carried more than 3½ million passengers and have flown nearly 200,000,000 miles!

To her passengers the Stratocruiser represents the acme of luxury and comfort—just as did the Boeing 40s, the 80As, the 247 and the Stratoliner in their day. For Boeing-built transports have been carrying passengers over a longer continuous period than those of any other American company.

Roominess, comfortable extra-large seats, wide aisles, low sound level—these are some of the features which make the Stratocruiser the first choice of knowing travelers.

Great airplane that the Stratocruiser is, she will be far eclipsed by the Boeing 707s, America's first jet transports. These newest Boeings—the 707 Stratoliner and the Intercontinental—are now being built for leading American and European airlines. Deliveries start in 1958 with first service scheduled for early 1959.

These new Boeing jets will bring you new luxury, distance-devouring speed and unimagined smoothness of flight. They represent yet another outstanding Boeing contribution to air travel.

BOEING

More Airline Reports Filed Listing Salaries of Officers

The following reports of salaries of officers and directors of scheduled airlines have been filed with the Civil Acronautics Board:

Pan American-Grace Airways, Inc., Douglas Campbell, vice president and general manager, $24,000 salary, $5,000 bonus and indirect compensation (down $2,000); T. J. Kirkland, vice president, $21,000 salary, $3,000 bonus and indirect compensation (down $1,000); K. A. Lawder, vice president and comptroller, $21,000 salary, $3,800 bonus and indirect compensation (down $1,200); E. G. Bern, vice president, $18,000 salary, $2,250 bonus and indirect compensation (down $750); C. S. Collins, assistant vice president, $13,500 salary (up $1,500), $950 bonus and indirect compensation (down $250); A. J. Phelan, assistant comptroller, $13,200 salary (up $1,200), $950 bonus and indirect compensation (down $250); W. F. Lewis, assistant treasurer, $11,750 salary (up $750), $600 bonus and indirect compensation (down $175); E. E. Spencer, assistant treasurer, $10,500 salary, $600 bonus and indirect compensation (down $175); Covington and Burling, legal services, $20,450 (up $9,450); Price Waterhouse, accounting service, $13,300 (down $3,500).

North Central Airlines, Inc., H. N. Carr, president and director, $23,542 salary (up $9,657); F. N. Buttomer, vice president-traffic and sales, $11,200 salary (up $1,296); A. E. Schwandt, vice president-industrial relations, $10,000 salary (up $96); R. H. Bendio, vice president-maintenance and engineering, $10,887 salary; A. D. Niemeyer, vice president-operations, $11,000 salary; B. Sweet, secretary and treasurer, $7,925 salary (up $1,728); A. E. A. Mueller, chairman of the board of directors, $2,604 salary (up $2,604), $225 bonus and indirect compensation (down $750); W. Christensen, director, $525 bonus and indirect compensation (down $225); G. F. Deggoursin, director, $600 salary (up $600), $450 bonus and indirect compensation (down $300); K. B. Willett, director, $525 bonus and indirect compensation (up $75); R. F. Grover, director, $450 bonus and indirect compensation (up $150); A. L. Wheeler, director, $450 bonus and indirect compensation (down $75).

Ozark Air Lines, Inc., B. T. Mattingly, chairman, $9,000 salary (down $375), $900 bonus and indirect compensation (up $440); L. Hamilton, president and director, $25,000 salary (up $4,792), $900 bonus and indirect compensation (up $440); A. G. Heyne, secretary and director, $3,600 salary (down $900), $900 bonus and indirect compensation (up $460); F. W. Jones, treasurer and director, $7,200 salary (down $300), $900 bonus and indirect compensation (up $580); O. L. Parks, director, $900 bonus and indirect compensation (up $600); G. O. Shaver, director and pilot, $11,040 salary (up $42), $900 bonus and indirect compensation (up $600); C. A. Bachman, director, $900 bonus and indirect compensation (up $720); A. A. Bluemeyer, vice president and director, $900 bonus and indirect compensation (up $600).

Piedmont Aviation, Inc., T. H. Davis, president, treasurer and director, $16,500 salary; R. D. Hager, vice president-traffic, assistant to the president and director, $11,520 salary; R. S. Northington, vice president-fixed base division and director, $8,225 salary (up $175); H. K. Saunders, vice president-operations, $14,400 salary (up $100); M. F. Fare, secretary and director, $8,500 salary (up $350); G. E. Anderson, director, $50 director's fee (down $50); E. L. Davis, director, $50 director's fee (down $50); E. L. Davis, Jr., director, $25 director's fee (down $50); W. Frank Dowd, director, $50 director's fee, (down $25); C. E. Norfleet, director, $50 director's fee (down $50); Kilpatrick, Ballard and Beasley, legal fees, $14,126 (up $1,624).

Southern Airways, Inc., Frank W. Hulse, president and director, $14,400 salary; C. M. Britt, vice president-sales, $16,541 salary; George F. Estey, secretary and treasurer, $10,800 salary (up $450); C. H. D. Tarrer, assistant treasurer, $7,665 salary (up $518); W. S. Magill, vice president, $14,293 salary.

Southwest Airways Co., J. H. Connelly, president and director, $21,000 salary (up $1,625); T. R. Mitchell, vice president, $14,101 salary (up $1,168); A. W. Johnson, vice president, treasurer and director, $13,500 salary (up $1,183); Raymond Costello, vice president and assistant secretary, $9,100 salary (up $380); Max King, vice president, $9,000 salary (down $300); Abbott Kimball Company, advertising services, $14,017 (up $3,017).

Trans-Texas Airways, R. E. McKaughan, president and director, $25,800 salary, $60 bonus and indirect compensation; H. E. Erdmann, vice president and director, $13,200 salary (up $200), $60 bonus and indirect compensation; L. J. Eichner, vice president, $11,600 salary; M. L. Muse, secretary-treasurer, $10,600 salary (up $800), $60 bonus and indirect compensation; J. K. Ayer, executive assistant to the president and director, $7,600 salary (up $2,800), $40 bonus and indirect compensation; W. C. Leatherwood, director and director of purchasing, $7,600 salary, $60 bonus and indirect compensation; J. M. Brooks, director, $60 bonus and indirect compensation; Clark, Coon, Holt and Reid, legal services, $42,400 (up $28,000).

West Coast Airlines, Inc., Nick Bez, president and director, $10,000 salary; G. H. Beasley, vice president and director, $16,500 salary; R. A. Duwe, secretary-treasurer, $9,600 salary; E. B. Code, vice president, $11,500 salary (up $1,100); T. R. Croson, vice president, $8,400 salary.

Helicopter Air Service, Chicago, John S. Gleason, Jr., president, treasurer and director, $1,400 salary; John C. Brogan, vice president and director, $2,100 salary; C. W. Moore, executive vice president and director, $12,000 salary (up $2,400), $3,000 bonus and indirect compensation; Robert B. Kiel, assistant secretary-treasurer, $9,600 salary (up $2,400).

Los Angeles Airways, C. M. Belinn, president and director, $22,500 salary, $2,250 bonus and indirect compensation; John T. Kane, treasurer and director, $8,700 salary, $870 bonus and indirect compensation; Donald L. Litton, assistant secretary (resigned 8-2), $2,870 salary.

New York Airways, Robert L. Cummings, Jr., president and director, $18,250 salary (down $25); Horace Brock, vice president and director, $14,400 salary; William W. Hogan, treasurer, $10,042 salary (up $542); Glen B. Eastburn, assistant to the president and assistant treasurer, $9,000 salary; Virginia M. Swain, assistant secretary, $3,888 salary; Hoyt Amidon, director, $225 salary; Paul Battilana, director, $225 salary; Robert E. Blum, director, $225 salary; Robert W. Dowling, director, $50 salary; Robert G. Goelet, director, $100 salary; Knox Ide, director, $175 salary; Grover Loening, director, $175 salary; Samuel C. Park, director, $250 salary; William Shields, Jr., director, $225 salary; Skadden, Arps, Slate and Timbers, legal services, $42,355 (down $1,895); George Daly Associates, public relations services, $10,454.

CAB ORDERS

(May 3-9)

GRANTED:

Capitol Airways permission to withhold a Military Operations Charter Contract with the Air Force from public disclosure.

Seaboard and Western Airlines an exemption to carry Mr. George Le Foll, a government courier, from New York to Paris with a shipment of classified cargo.

City of St. Louis and the Kenton County Airport Board permission to intervene in the Eastern Route Consolidation Case.

United Air Lines permission to intervene in the Seven States Area Investigation. Petition of North Central Airlines was dismissed as moot, and the petitions of Eastern Air Lines and Delta Air Lines were denied, as were petitions of 16 communities and organizations who were interested in the investigation.

Allegheny Airlines an exemption to lease one C-53 or DC-3 aircraft from Joel H. Carroll and Harry H. Hill, Jr.

Trans-Texas Airways an exemption to operate one daily round-trip flight between Laredo and Mission-McAllen-Edinburg, Texas, for one year.

Transocean Air Lines an exemption to perform a flight from Guam to Tokyo carrying school teachers from the Guam Public Schools.

City of Norfolk, Neb., and the Nebraska Department of Aeronautics permission to intervene in the investigation of Braniff Airways' service to points in the North Central states.

APPROVED:

Agreements involving Pan American World Airways, Air-India International and various other carriers relating to intercarrier arrangements.

Agreements involving Continental Air Lines, Delta Air Lines, and various other carriers relating to numerous intercarrier arrangements.

ORDERED:

Western Air Lines authority to operate its Rapid City-Salt Lake City route, the Casper Cut-Off, made permanent.

DISMISSED:

Trans Caribbean Airways and Riddle Airlines applications to operate between Miami and Rome via San Juan, at the request of the applicants.

DENIED:

Applications of Eastern Air Lines and the Chamber of Commerce of Metropolitan St. Louis for exemption authority for nonstop service between St. Louis and New York.

City of Gunnison, Colo., and the Gunnison County Chamber of Commerce permission to intervene in the Phoenix Service Case.

Railway Express Agency petition to suspend or defer tariffs filed under terms of the CAB's decision on deferred air freight service.

Frontier Airlines and North Central Airlines permission to intervene in the investigation of Braniff Airways' continued service to various points in the north central states. Permission to intervene was granted to the Aviation Committee of the Norfolk, Neb., Chamber of Commerce; the Airport Board of the City of Brookings, S. D.; the North Dakota Aeronautic Commission; the City of Mitchell, S. D., and the Mitchell Chamber of Commerce; the City of Watertown, S. D. and the Watertown Chamber of Commerce; the City of Yankton, S. D., and the State of Minnesota.

Be an ensign in 4 months. The new AOC Program for college graduates, 19 to 26, puts you through 14 months of flight training as an ensign at $438.58 a month.

As a Naval aviator you will travel the world on one of the Navy's new supercarriers, or the newly modernized carriers with angled decks and steam catapults.

New F9F-8T Cougar, a two-seat transition fighter for carrier operations and supersonic flight, is a modified version of the Grumman F9F-8 Cougar, standard Navy jet fighter.

DILBERT NEVER HAD IT THIS GOOD

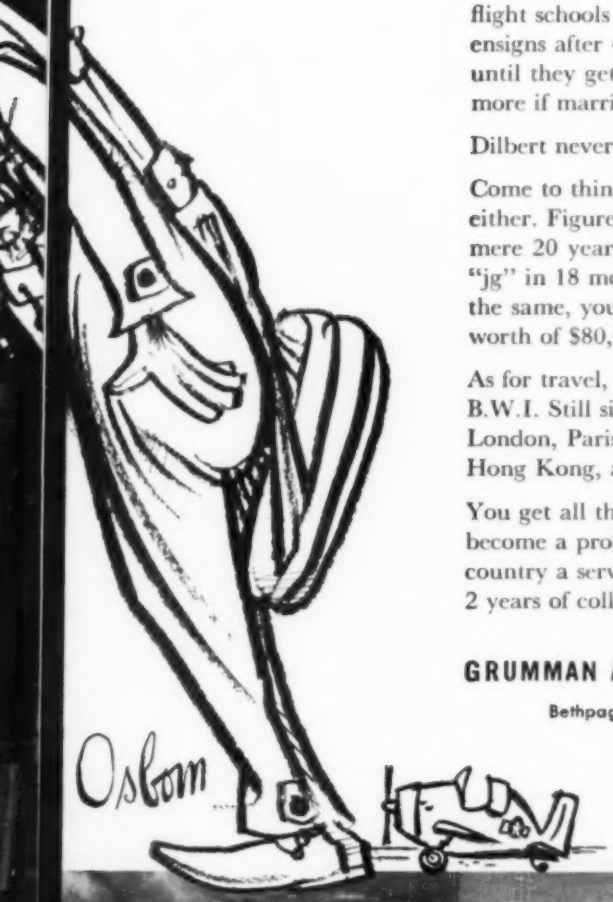
College graduates who join the new Navy Aviation Officer Candidate Program really have it made. Instead of going through flight schools as cadets, kept single by regulations, they are made ensigns after 4 months of preflight school. For the next 14 months, until they get their wings, they earn $438.58 a month, more if married.

Dilbert never had it that good.

Come to think of it, many a civilian doesn't have it as good either. Figure the retirement pay these ensigns will draw after a mere 20 years. With minimum normal promotions (ensigns make "jg" in 18 months) they'll get $280.00 a month for life. To get the same, you would have to pay $35.00 a month for 20-years worth of $80,000 endowment insurance.

As for travel, glance at George in the picture taken in Jamaica, B.W.I. Still single and only 26, George has already been to London, Paris, Madrid, the French and Italian Rivieras, Rome, Hong Kong, and Tokyo.

You get all these benefits and more, plus a $70,000 training to become a professional pilot. In return you will be doing your country a service. For details about AOC and NavCad (only 2 years of college required) write: NavCad, Washington 25, D.C.



GRUMMAN AIRCRAFT ENGINEERING CORPORATION

Bethpage • Long Island • New York

The Grumman F11F-1 Tiger is a slick new jet fighter capable of supersonic speeds in level flight and was the first airplane to fly with the new Area Rule "Coke bottle" fuselage.

The Grumman twin-engine S2F sub-killer, along with the carriers and destroyers, make up the Hunter-Killer Group, the Navy counter weapon against submarines.

Designers and builders of the supersonic F11F-1 Tiger, transonic F9F-8 Cougar, S2F sub-killer, SA-16 Albatross rescue amphibian, metal boats, and Aerobilt truck bodies.

Cline Electric

HELPS MAKE TRUTH OF SCIENCE FICTION

Reaching into the future for a problem and solving it today, Cline Electric Manufacturing Company is helping to make the fabulous world of tomorrow come true.

Developments such as Cline's wide-frequency-range **Magnetic Amplifier Exciter Voltage Regulator and Magnetic Speed Positioning Devices** for aircraft reflect Cline's ability as a leading designer and supplier of electrical and electronic equipment.

AIRCRAFT PRODUCTS DIVISION

Controls by **CLINE ELECTRIC**

BUILDING PRECISION INTO TARGET ZERO

Cline Wide-Frequency Range (380-1000 Cycles) Magnetic Amplifier Exciter Voltage Regulators

CLINE ELECTRIC MANUFACTURING COMPANY · 3405 West 47th Street · Chicago 32, Illinois

Shortlines

▶ **Air Transport Assn.** reports U. S. scheduled airlines flew 221,752,000 revenue ton-miles in February, 14% more than in February 1955. Passenger-miles were up 14.6% to 1,858,896,000 in the same period. . . . Airlines Clearing House handled $158,721,659 in interline business in the first quarter, an increase of 16.6% over the 1955 first quarter.

▶ **Aer Lingus** carried 402,255 passengers in the fiscal year ending in March. The London-Dublin service accounted for 175,695 passengers, as compared with 149,051 for the same period of last year.

▶ **Air France** reports traffic increases of 18% in passengers and 13% in passenger-miles for 1955. North American Division traffic increased 22% during the year, and the Air France system load factor was 71% for 1955.

▶ **Allegheny Airlines'** first quarter traffic increased by 27% over the same period for 1955 to 11.4 million passenger-miles. Bad weather held the completion record to 84%.

▶ **American Petroleum Institute's** Aviation Technical Service Committee has set up a study of methods for fueling turbojet and turboprop transports. Particular attention will be given the DC-8, Boeing 707, Convair Skylark and Lockheed Electra.

▶ **Braniff Airways** reports a net operating profit after taxes of $362,500 for the first quarter of 1956. This is a record net profit for the period and represents an increase of 230% over profit for the 1955 first quarter. Braniff says these results include introductory operating losses on the new routes to Washington and New York.

▶ **British European Airways** had a profit of about $1.4 million after taxes in the year ending March 31. During the year, BEA carried 2,225,000 passengers, had total revenues of $60 million.

▶ **British Overseas Airways Corp.** increased passenger traffic between New York and London 22% to 54,828 passengers in the year ending March, 1956 . . . BOAC will replace Super Constellations with Viscounts on a daily tourist service from New York to Bermuda beginning May 1.

▶ **Canadian Pacific Airlines** will start service June 2 between Vancouver and Buenos Aires via Toronto, Mexico City and Lima.

Electronic Flight Board

Arrival and departure times of some 250 flights daily are posted electronically on information board at Hopkins Municipal Airport, Cleveland, Ohio. The board, installed recently in the airport's new $6,500,000 terminal building, was manufactured by Spencer Displays, New York, at a cost of approximately $96,000.

▶ **Emery Air Freight Corp.** had net income of $114,786 on gross revenues of $2,072,843 in the first quarter of this year. Net profit for the same period last year was $55,668 and revenues were $1,509,863.

▶ **Ethiopian Airlines** has scheduled five flights a week this summer between Addis Ababa, Cairo and Athens with Convair 240 equipment. The airline recently completed negotiations with Sabena for the purchase of a third Convair 240 to fly with its fleet of eight DC-3s.

▶ **Japan Air Lines** purchase of four DC-7Cs brings Douglas' total orders to 105. Delivery is scheduled for early 1958.

▶ **Mohawk Airlines'** first quarter traffic increased by 35% over the same period of 1955. The load factor reached 55.22%. Mohawk carried 28,605 passengers in April, 31.5% above the previous April figure. Load factor increased to 57%.

▶ **North Central Airlines** carried 43,131 passengers in April and 153,509 passengers in the first four months of 1956. The January-April traffic increased 56% over the same period last year.

▶ **Ozark Air Lines'** April passenger traffic showed a 24% increase over April, 1955. The airline flew 26,103 passengers last month and reported a four-month total of 91,898.

▶ **Pan American World Airways** reports 54,408 passengers traveled through its Miami gateway in April as compared with 44,039 in April of the previous year. During the month, 23,857 passengers departed for Latin America and 30,551 returned.

▶ **Riddle Airlines** flew 7,796,656 lb. of cargo during the first quarter of the year as compared with 5,533,029 lb. for the same 1955 quarter. Cargo traffic in March was 3,053,144 lb., a 64% increase over the previous March.

▶ **Seaboard and Western Airlines** flew 3,726,000 cargo ton-miles in the first three months of 1956, an increase of 73% over the first quarter of 1955.

▶ **Southern Airways** flew 15,888 passengers and 2,785,034 passenger-miles in April as compared with 14,407 passengers and 2,484,763 passenger-miles in April, 1955. The April 1956 load factor was 47.9%.

▶ **Trans-Australian Airlines** has taken up its option on two Vickers Viscount 810D transports for mid-1958 delivery. The order brings total Viscount sales to 306.

▶ **United Air Lines** has ordered an $800,000 DC-8 simulator from Link Aviation, Inc. The simulator will be installed in 1958, about a year before delivery begins on United's DC-8 order . . . United flew 346,215,000 passenger-miles in April, A 10.5% increase over the previous April.

Patuxent River Tests Navy Aircraft for

By Dale W. Cox, Cdr., USN*

Patuxent River, Md.—Four divisions of the Naval Air Test Center here have the last word on the suitability for Fleet use of all the Navy's new fixed- and rotary-wing aircraft.

Patuxent is to naval aviation what Edwards, Eglin and Wright-Patterson AFBs are to the Air Force. The Air Force installations are much more extensive, but the Navy feels there is an advantage in having all test units on the same base. Project pilots from the four divisions personally can compare notes at intervals through the test flying programs.

These are the four divisions and their functions:

- **Service Test** checks the operational and tactical suitability of the airplane as a fighting machine for the fleet, paying particular attention to maintenance.
- **Flight Test** evaluates stability and control, performance of the plane and engine, and the carrier suitability.
- **Armament Test** determines the abilities of the aircraft as a weapons platform.
- **Electronics Test** conducts a technical evaluation of all avionic equipment.

Soon after the first flight of a new airplane, the Navy sends a pilot team from Patuxent to the contractor's plant to fly the new craft. This is a Navy Preliminary Evaluation, a brief, formal series of tests to discover any major discrepancies in the experimental model prior to sending production planes to Patuxent. Of primary interest are qualitative opinions on stability and control and rough quantitative data on performance.

General Test

Contractor instrumentation in the X model is used to find yaw angle, rate of roll, thrust, stick force, and other information necessary to arrive at general opinions on flying qualities and performance. The Flight Test Division of the Naval Air Test Center is responsible for this evaluation and the written report to the Bureau of Aeronautics (BuAer).

Typical forms of trouble these tests uncover:

- **Poor location of instruments or equipment.** (The Mock-Up Board probably looked at paper cutouts of equipment. When pilots start to use the equipment, to the frustration of the manufacturer, they often prefer to have it arranged differently.)
- **Poor handling and controllability** in the carrier approach attitude.
- **Objectionable high speed characteristics.**

After this first look, the contractor, BuAer and Patuxent decide whether the objections require fixes prior to delivery. Several months pass during which the contractor's pilots are busy increasing the flight envelope and the engineers come up with changes requested in the first evaluation.

Again a Navy Preliminary Evaluation is organized and Patuxent pilots fly the modified experimental model. A second report of these qualitative tests is made to BuAer and additional fixes may have to be engineered into the X model and the production line. Should this second evaluation indicate, on the other hand, that the plane is ready for its formal trials at Patuxent, no further tests are made by the Navy at the contractor's test facilities. Contractor pilots continue to increase and demonstrate the flight characteristics of the airplane until a series of tests called SR38 Part I Demonstration have been completed. Then the Navy is ready to flight test the airplane at Patuxent.

Y Models

When the first seven fighters roll off the production line they are designated Y models and picked up by Patuxent pilots for the Board of Inspection and Survey (BIS) trials. BIS is an organization independent of the Test Center to whom the Commander of the Naval Air Test Center reports the results of the trials made on each new model airplane. The Board of Inspection and Survey, in turn, reports directly to the Secretary of the Navy on the suitability of all ships and airplanes bought for the Navy.

Each test division receives at least one Y model. The first testing program for these airplanes is called the Preliminary Evaluation Phase of the BIS Service Acceptance Trials. These preliminary tests, which must be completed within 60 days, are accelerated under the highest priority in order to arrive at an early opinion as to whether the plane meets the design specifications and whether Fleet deliveries should commence. (Up to this time no aircraft have been delivered to the Navy other than the Y models.)

At a conference at BuAer, the contractor, BIS, the four test divisions, and any other interested contractors meet to decide on fixes necessary before

The views expressed in this article are those of the author, and not necessarily those of the Navy Department or the Naval Service as a whole.

GROUND INSTRUMENTS, observers record data from a low-level pass by an F4D-1.

Sea Duty

Fleet delivery. When this conference is completed, the contractor incorporates the changes in his production line agreed upon and modifies all planes ready for Fleet delivery.

Squadron Introduction

While testing of the Y model airplanes continues, another program commences at Patuxent involving the Service Test Division. This is called the Fleet Introductory Program, the object of which is to train pilots and ground crews of the first AirLant and AirPac squadrons who are to operate the new airplane (AW February 28, 1955, p. 22).

Upon arrival at Patuxent the 12 pilots and 60 ground crewmen selected fly every type of mission expected of their squadron. The program results in approximately 700 flight hours on six subsequently produced planes. Excellent parts usage data and ground upkeep experience from contractor mechanics is gained for the squadron maintenance personnel, besides the flight proficiency gained by the pilots. After the introductory program, the Fleet is ready to commence operating the airplane.

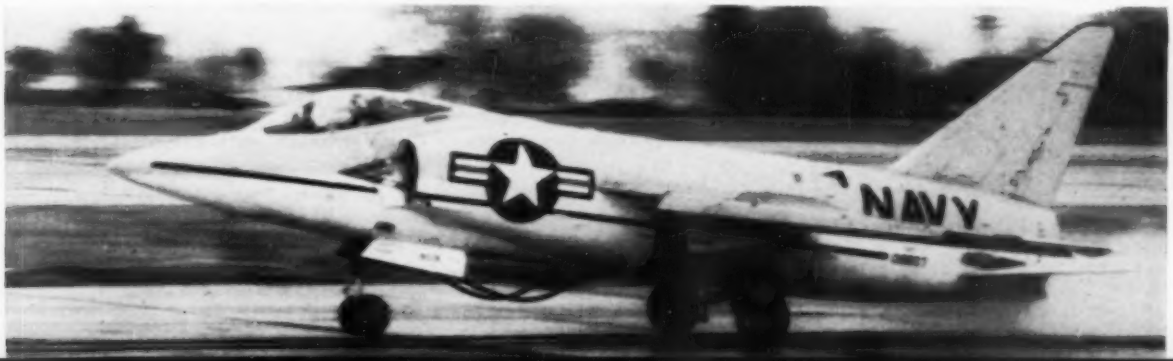
The Fleet Introductory Program at Service Test runs concurrently with the regular BIS trials. For its part of the BIS trials, Service Test Division first carries out an extensive acceptance check.

The Maintenance Department of Service Test watches for difficult accessibility to internal hardware, evidence of sloppy workmanship in the airframe, poor operation of hydraulic and pneumatic equipment, difficulties in engine removal and the like. The maintenance men also verify availability of any special tools, handling equipment, or starting units.

All systems are given thorough ground tests. After the acceptance check, Service Test pilots commence

PATUXENT ANSWERS: Will the YA3D, the F3H-2N or the YF4D-1 fly with the Fleet?

NAVY FIGHTERS must be evaluated for structural integrity in carrier operations. Here an F11F-1 is fired from a steam catapult.



Systems Engineering at The Ramo-Wooldridge Corporation

ICBM and IRBM are prime examples ■ The Intercontinental Ballistic Missile and the Intermediate Range Ballistic Missile, Air Force programs for which we have over-all systems engineering and technical direction responsibility, are prime examples of programs that require the systems engineering approach. Most Ramo-Wooldridge work is of such a systems character, requiring the concurrent solution of a wide variety of interrelated technical and operational problems. Additional examples at R-W are communications, fire-control, and computer programs for the military, and automation and operations research projects for business and industry.

Pertinent technical fields ■ Successful execution of systems engineering programs requires that the technical staff include experts in a considerable number of scientific and engineering specialties. At Ramo-Wooldridge some of the pertinent fields are aerodynamics, propulsion, digital computers, information theory, radio propagation, radar, infrared, servomechanisms, gyroscopy, and nuclear physics.

The kind of team required ■ A qualified systems engineering staff must include unusually capable theoreticians and analysts who can predict the behavior of complex systems, as well as ingenious experimental physicists who can devise suitable new techniques for measuring actual physical parameters. In addition, the team must include experienced apparatus and equipment development engineers, to insure a high level of practicability in the resulting end products.

Scientists and engineers who are experienced in systems engineering work, or who have specialized in certain technical fields but have a broad interest in the interactions between their own specialties and other fields, are invited to explore the wide range of openings at The Ramo-Wooldridge Corporation in:

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Runs Navy Air Testing

Rear Admiral Clifford H. Duerfeldt has been commander of NATC since March, 1954. A graduate of the Naval Academy and an aviator since 1929, he has served as commanding officer of the aircraft carriers Sicily and Tarawa.

His administrative duty includes tours in the office of the Deputy Chief of Naval Operations (Air) and as Assistant Director of the Aviation Plans Division. He was co-pilot of the first Navy non-stop transcontinental flight, made by an XPB2Y in 1938.

around-the-clock flying to determine the tactical suitability, all-weather suitability, and the operational safety and reliability of the airplane.

In evaluating tactical suitability, the new plane's performance, maneuverability and fighting ability are compared with other first-line Navy fighters where it counts—in the air. Two pilots alternate in flying the new plane alongside another to learn the weaknesses and advantages of the new plane. If possible a new fighter is flown against the U. S. Air Force's MiG-15.

Every mission expected of the new plane is flown under simulated combat conditions. All ordnance equipment is operated many times to ensure that the installation is satisfactory in combat maneuvers. Turn-around cycle time and the ability of Fleet ordnance personnel to handle the armament equipment are important aspects of the plane's tactical suitability.

High Speed Check

High speed characteristics are investigated extensively. Service Test wants to know whether the plane can outmaneuver enemy fighters in combat situations, as in a tail chase. With an enemy on its tail, will the performance characteristics give Navy pilots the chance to regain the initiative?

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catapults and into arresting gear to determine whether Fleet pilots will have any problems and whether repeated carrier work will accelerate any equipment failures. Scramble time, acquisition time, best fighting speed and tactical Mach number are other samples of information obtained for evaluation.

The airplane is flown under all instrument conditions and at night to determine its all-weather capability. Specifically, these items are evaluated:

- **Instrument handling characteristics.**
- **Flight instrumentation.**
- **Lighting—external and internal.**
- **Cockpit layout and crew comfort.**
- **AI or fire control radar.**
- **Radio aids and other electronic** navigational aids, including the navigational aspects of the radar.
- **Requirements for IFR scramble.**
- **IFR letdown, approach,** and landing characteristics.
- **Thunderstorm penetration.**
- **Anti-icing and de-icing equipment.**
- **Night catapult and night arrested** landing characteristics.

Operating techniques for jet penetrations and letdown are devised. Best approach speeds and attitudes for GCA landings are determined as well as time and fuel consumption data during these maneuvers. Cockpit layout and night lighting are checked comparatively against the best available in other fighters.

Experimental instruments such as new gyro horizons are installed and compared with the performance from the existing equipment.

The operational safety and reliability evaluation requires a minimum of 300 flight hours to determine engine and systems reliability. If possible, cold weather flights are flown.

Throughout all flying and ground servicing at Service Test, safety items are searched for. Flight items such as ease of scanning the oxygen blinker, ejection provisions, ditching procedures and air-start reliability are evaluated. Numerous dead stick landings are made to determine the best techniques. Ventilation, heating, cooling, pressurization provisions, water tightness, sound level and carbon monoxide concentration are checked.

Ready for Fleet

At the end of the BIS trials, Service Test has flown the airplane simulating every tactical operating situation that is to be expected of the new plane. They know whether the plane is ready for operational use with the Fleet.

Flight Test generally receives two of the Y-models delivered for BIS trials. One goes to the Carrier Section for stability and control, and performance tests; the other to the Carrier Suitability Section where the ability of the plane

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To the Strategic Air Command, now celebrating its tenth anniversary, each extra hour allowed B-47 engines can mean up to 500 air miles. G.E.'s recent 300-hour increase means 150,000 more miles (300 × plane's average speed of 500 mph) of efficient operation for the Boeing aircraft . . . as many as 12 more long-range missions before the engines must be pulled.

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The J47's record is one more example of G-E aviation achievements. But at G.E., the goal remains: more progress. When the J79 turbojet—G.E.'s newest and most powerful—joins Air Force and Navy squadrons, it too will make a tremendous G-E contribution to U.S. aviation. General Electric Company, Cincinnati 15, Ohio. 235-3

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to operate from aircraft carriers is evaluated.

For the BIS Stability and Control Trials, Flight Test uses a completely instrumented airplane. Prior to commencing actual test work, the air speed and altimeter position errors are determined, generally by the conventional altimeter depression method. Typical flying qualities determined at forward and aft center of gravity positions and at aircraft gross weights critical for the characteristics under test:

- **Dynamic longitudinal stability.**
- **Maneuvering longitudinal stability.**
- **Elevated control effectiveness.**
- **Longitudinal trim changes.**
- **Static lateral–directional stability.**
- **Lateral and directional trimability.**
- **Stability and control characteristics** in power approach, landing and wave-off.
- **Mach number effects** on stability and control characteristics.
- **Suitability of artificial feel** in power controlled systems.

For the BIS Aircraft and Engine Performance Trials the airplane's empty weight, instrumentation and static thrust are checked prior to flight. These trials produce data on:

- **Stall speeds** in various maneuvers, obtained by pacing aircraft.
- **Take-off performance** including minimum take-off run and take-off speed obtained from photographic data.
- **Gross thrust available and required** over a range of gross weights and altitudes to give a performance curve. From this V_{max} vs. altitude curves are determined.
- **Climb performance** such as minimum time to service ceiling and best climb schedule. Thus, Flight Test pilots obtain specific data to judge whether or not the airplane meets the contract guarantees.

The BIS Carrier Suitability Trials are divided into the catapult launching, arrested landing, barrier arresting and carrier qualification phases. Prior to flight, careful static measurement of airplane gross weight, horizontal and vertical center-of-gravity position and critical clearances are made. Catapult and arrested landing phases start at minimum gross weights and speeds, gradually reach maximum guaranteed weights, speeds and load factors.

These tests determine:

- **Suitability of airplane catapulting** and arresting equipment.
- **Dynamic and aerodynamic characteristics** of the airplane after being catapulted and arrested.
- **Structural integrity** after maximum load factor catapult and arrested landing tests.

The barrier arresting phase normally determines that the airplane has the correct geometry and clearances for

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barrier arrests. If BuAer directs, actual barrier engagements are made. The carrier qualification phase ascertains the suitability of the new airplane to be taken to sea for its actual carrier tests.

The BIS Armament Trials for fighters are broken down into tests of automatic flight control equipment, fire control systems, fixed guns, pyrotechnic and chemical devices and missiles.

Armament Test receives one Y model for BIS trials. Ground tests check:

- **Ease of removal** and replacement of guns.
- **Ease of loading,** clearing jams and emptying cases of fixed guns.
- **Effects of gun fire** on fire control equipment, other ordnance equipment and engine operation.
- **Actuation time lags** on release circuits of bombs and rocket systems.
- **Safety features** for loading and unloading of stores.
- **Interchangeability** of ordnance equipment such as bomb racks, rocket launchers and gun packages.
- **Adequacy of stowage,** loading and unloading of chemical stores.
- **Adequacy, reliability, and general** functioning of guided missile installations.

The airplane then is ready for operation of all armament systems in the air. For the automatic flight control phase, the structural and functional suitability of the equipment is determined after imposition of both positive and negative flight accelerations representative of those expected in combat. The ability of the equipment to control the airplane automatically through a combat problem is ascertained.

Gun Accuracy

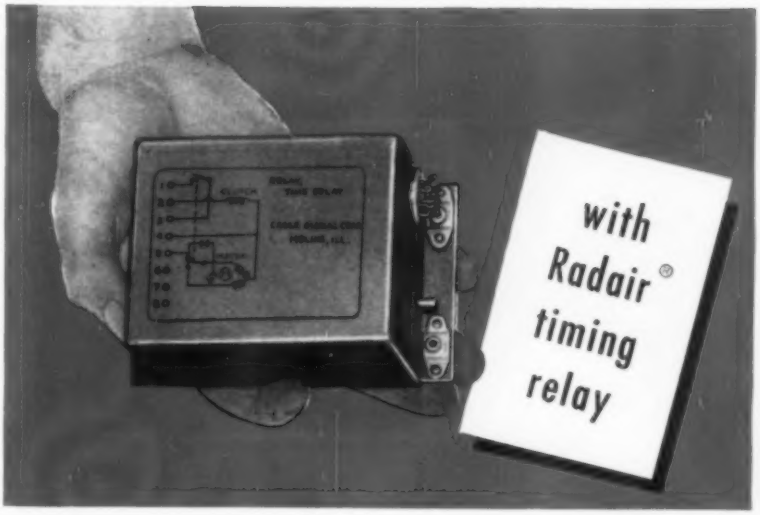
Flight tests to evaluate fixed guns determine the adequacy, accuracy and reliability of the gun installation through attempted 100% firouts from sea level to within 2,000 feet of the service ceiling. Particular emphasis is paid to any gun effects on aircraft controllability or engine operation. Discrepancies such as muzzle flash at night, pitting of canopy, gun gas concentration and damage from ejected linkages are carefully observed.

If applicable, in addition to checking the adequacy, accuracy and reliability of delivering chemical stores, related problems such as the extent of contamination of inhabited compartments by chemicals during dispensation are carefully measured.

The guided missile phase insures that the missiles fit, can be carried and fired from the airplane properly. The suitability and reliability of the airplane as a guided missile platform are evaluated under simulated combat conditions.

Through all of this flying, Armament Test pilots compare the results obtained with the new against both older

Electronic equipment back in action at "tube-reheating" speed



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types and Navy standards. An Assessment House transforms photographic and oscillograph data into a numerical measure of the fire control system's performance.

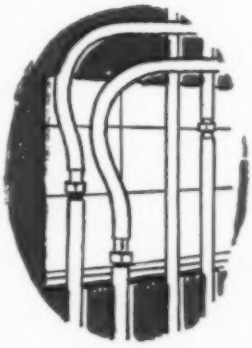
Electronics Test is the organization at Patuxent to assure that the ever growing number of black boxes in airplanes are manufactured properly, operate according to specifications and function correctly in the airplane. Particular attention is paid to evidence of voltage breakdown, the formation of sparks, arcs or open flames and proper functioning of safety circuits. Representative of the work done:

- **Communication equipment is** tested at various altitudes and the maximum reliable range for satisfactory service is determined.
- **IFF equipment is flight tested** for antenna patterns and range performance.
- **Maximum ranges for various types** and sizes of targets and dropout of target at altitudes are determined for radars.
- **Electronic navigational equipment** of all types is tested, such as homing equipment, Loran, marker beacons, range receivers, omni receivers, Tacan, and direction finders.
- **Electronic countermeasures (ECM)** equipment is checked to assure its meeting design criterions and that it is operationally suitable.
- **Performance of Airborne Magnetic** Detection (MAD), sonobuoy receivers and airborne sonar equipment, if installed, is precisely measured over simulated submarine targets and the results compared with that from other airplane installations.
- **Acoustic level in the airplane** at all crew stations is measured to decide by BuAer instructions if the noise level is acceptable.

Electronic Test's evaluation for the electrical equipment phase of the BIS trials is designed to determine the actual electric power requirement of the airplane. The generating equipment must be able to supply this requirement under actual operating conditions, without exceeding recommended ratings.

Other Testing

BIS Trials involve approximately 40% of the flight hours and efforts at Patuxent. The remainder of the work encompasses testing new engine developments, experimental instruments, modified seaplane hulls, new fire control systems, improved electronics equipment and similar developmental testing requested by BuAer. A Test Pilot Training Division also is under the Test Center commander. Whatever the project, Patuxent pilots flying their test flights have one objective. That is to improve the planes delivered to the Fleet.



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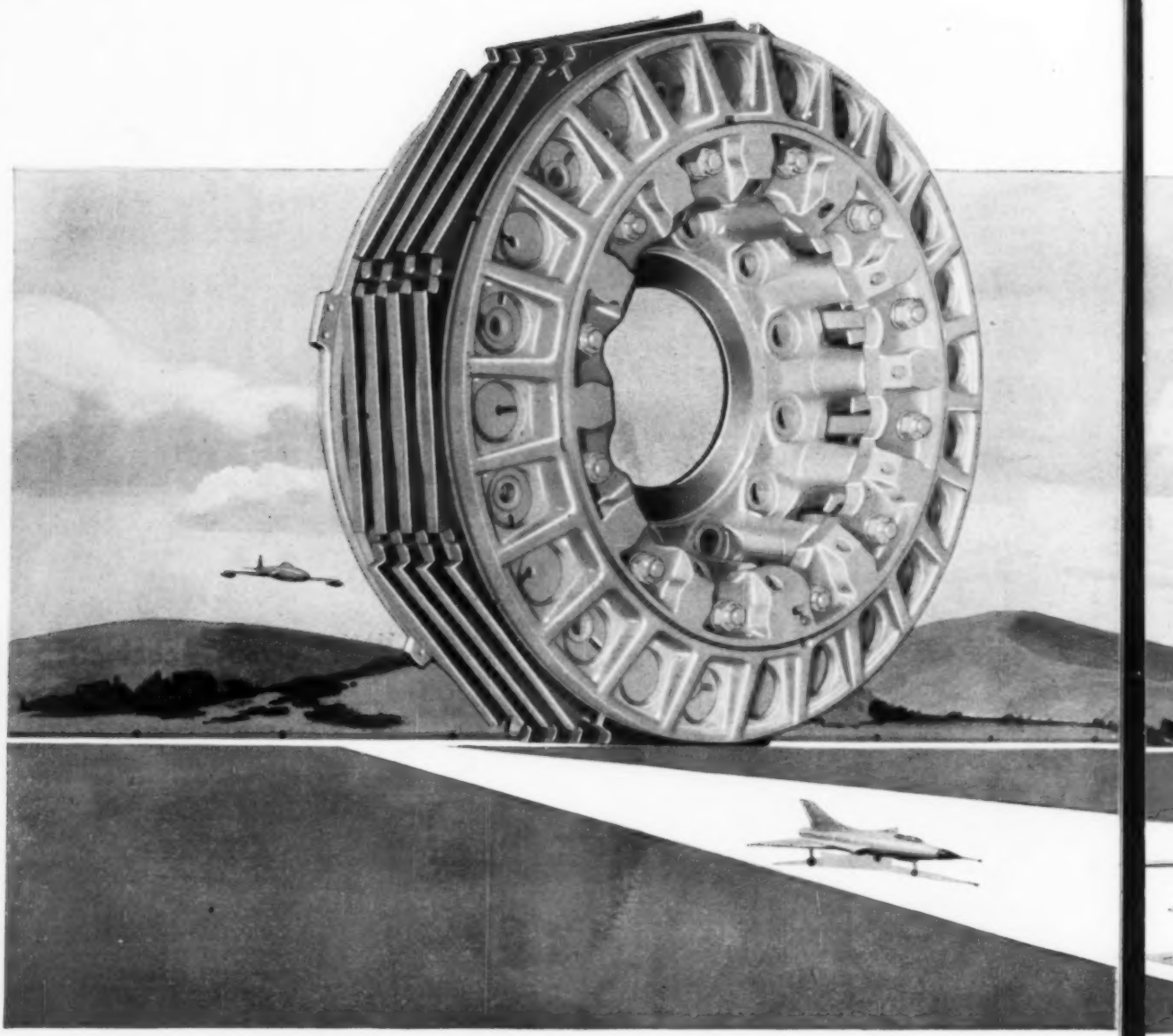

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Here is an unbeatable combination—the Bendix Segmented Rotor Brake and Cerametalix* brake lining.

These two were made for each other—literally! For Cerametalix was developed by Bendix for Bendix* brakes; then, the brake itself was proportioned to take full advantage of this new kind of lining.

NO FADE. The result is a brake that will not fade, fuse or lose friction, even when the linings run red hot.

LESS MAINTENANCE. Adjustments are less frequent and linings last several times longer.

NO WARPING. Cerametalix is a good conductor of heat. This, combined with the exclusive Bendix segmented rotor, eliminates warping and welding of friction surfaces.

CERAMETALIX

It all adds up to a new high in brake performance—a brake that can be depended upon under the toughest conditions from touch-down to the end of the landing run!

Bendix brake stator faced with Cerametalix—an entirely different kind of friction material that has amazing resistance to heat and wear. As a result, friction loading and energy absorption can be approximately doubled.

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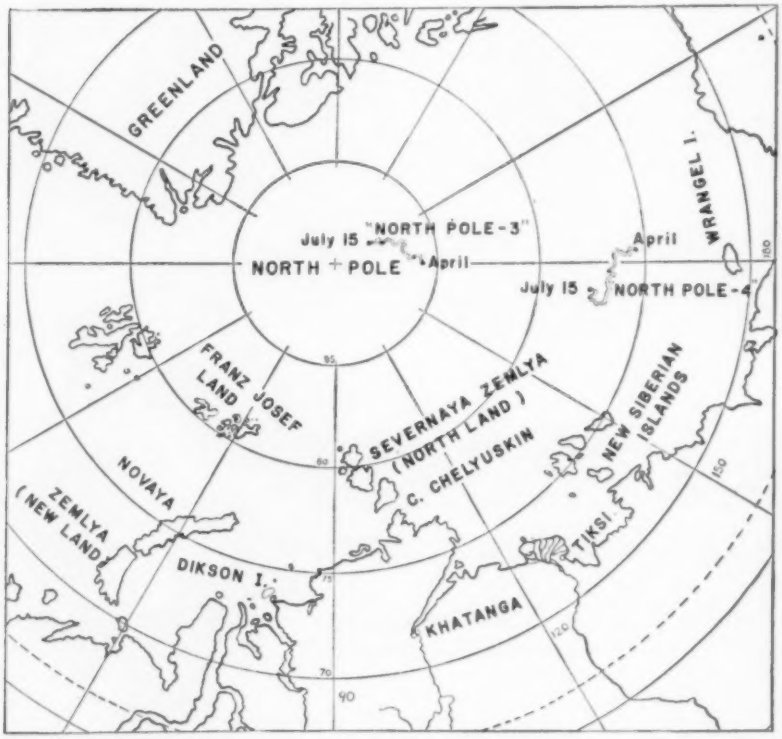
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

SMALL AIRBORNE BULLDOZER is used to move cargo off-loaded from Il-12 "Coach" in Soviet airlift to ice floe bases North Pole 3 and North Pole 4. Aircraft provide all logistic support for Soviet expeditions and are used for reconnaissance.



IN THE FIRST THREE MONTHS the bases drifted 250 miles closer to the pole. In a year NP-3 drifted past the pole and headed into the Greenland Sea, covering 1,400 miles.

THE "CAB" (DC-3) is widely used to supply Russian polar explorations.

LEADERS plan geophysical studies.

PORTABLE combustion heater is used to ready Il-12 for starting.

SLED DOGS and "Hound" helicopter are used for short-haul work.

Air Support Vital in Red Polar Operations

Nearly two years of recent polar operational experience are behind the Soviet antarctic expedition for the International Geophysical Year. Two permanent drifting ice floe bases, established near the North Pole in April 1954, apparently were in operation throughout 1955. The bases, called North Pole 3 and North Pole 4, were completely dependent upon airlifted supplies. Exploration teams were largely airborne. The bases were built because of interest aroused by the discovery in 1948 of the underwater "Lomonosov Ridge" extending from the New Siberian Islands to Greenland and Ellesmere Island.

Russia is also currently using aircraft to supply a number of towns that have recently been established along the northern coast of Siberia and for iceberg reconnaissance along Russia's northern sea route.

THE LAZ-69 LIGHT TRUCK is the Russian equivalent of the jeep and can be airlifted by the "Hound" helicopter.

Airborne Weight, Strength Study Recommended by Engineers

By Irving Stone

San Diego—A recommendation that the Department of Defense make a study to determine the dollar value of establishing minimum weights in airborne components was made at the 15th Annual National Conference of the Society of Aeronautical Weight Engineers.

C. L. Baer, Northrop Aircraft's Engineering Weight Section assistant supervisor, told the 125 engineers attending the conference that more of the data to be analyzed in such a project is available to the Department of Defense than to individual contractors.

Baer suggested that operations analysis engineers of various companies gather enough data on some aircraft and weapons to permit a preliminary weight-cost study such as was made at Northrop on the Scorpion F-89D. The Northrop study showed how the value of saving a pound of weight varied between four and ten times the cost of manufacturing an airframe pound.

Discussing Boeing Airplane Co.'s material comparison studies, D. D. Cox, weight unit chief of the company's Seattle Division, said titanium alloy in skin-and-stiffener combination or in sandwich form is superior to steel on a strength/weight basis at elevated temperatures up to 800F for long periods of exposure. Because of this he said, Boeing believes the long-range supersonic aircraft of the future should be built of titanium alloys.

Titanium Competitive

Boeing studies also have shown that titanium alloys are competitive, on a strength/weight basis, with aluminum alloys for certain primary structural applications on present day aircraft designs.

For the thin wings required for supersonic flight, Cox said sandwich construction offered considerable weight advantage over conventional skin-and-stringer construction. This is because the bulk of the material is located nearer the surface of the wing, giving a greater beam depth and resistance.

Another advantage of the sandwich construction is that it provides greater torsional rigidity per pound of weight. This is important with thin wings where flutter may be a serious problem.

Design, Test, Redesign

"One of engineering's most important roles in missile development is in convincing people who are not in engineering that we do not have infinite knowledge; that we must design, construct and test, and then redesign, reconstruct and retest in several cycles, then finally flight test the article," Dr. W. F. Ballhaus Northrop chief engineer, told the weight engineers.

"We must expect failures in the program, but must always define the problems clearly, recognize and solve them, so that ultimate capabilities of the system can be realized."

Cox said the higher thrust engines used for supersonic flight aggravate the problem by causing more noise pressure on aircraft structure. This can greatly influence the location of engines. Also, weight may have to be added to structure to withstand additional noise pressure.

Closer Cooperation

R. E. Knight, Goodyear Aircraft Corp. aerodynamicist, urged closer cooperation between the weights engineer and the aerodynamicist. Knight said an

XB-47D Testing T49 Engines

Two Boeing XB-47D Stratojets are continuing the flight test program of Curtiss-Wright T49 turboprop engines. The T49s are mounted inboard, each replacing two General Electric J47 turbojets. Outboard J47s are in place. Refuelling receptacle is open on this XB-47D indicating that tests have been conducted using refuelling techniques.

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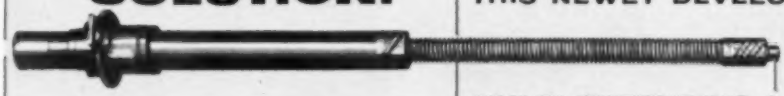
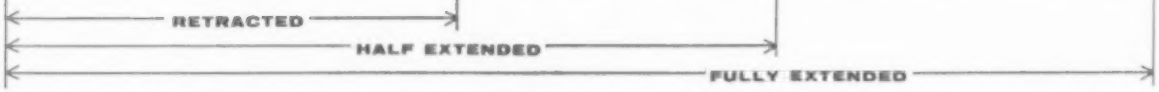
SOLUTION: THIS NEWLY DEVELOPED



SAGINAW MULTI-EXTENDING b/b SCREW EXTENDS SEVERAL TIMES ITS RETRACTED LENGTH



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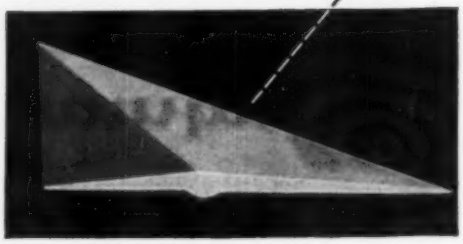
DIMENSIONAL TOLERANCES				SURFACE FINISH	
Mis-match	1/64" Max.	Thickness	—0 +1/32"	Parallel to base	125 RMS
Length	±1/32"	Angular	±1/2°	Perpendicular to base	250 RMS
Width	±1/32"	Straightness	.010" in 10" length	Local depressions	.005" per inch length .015" maxm. depth



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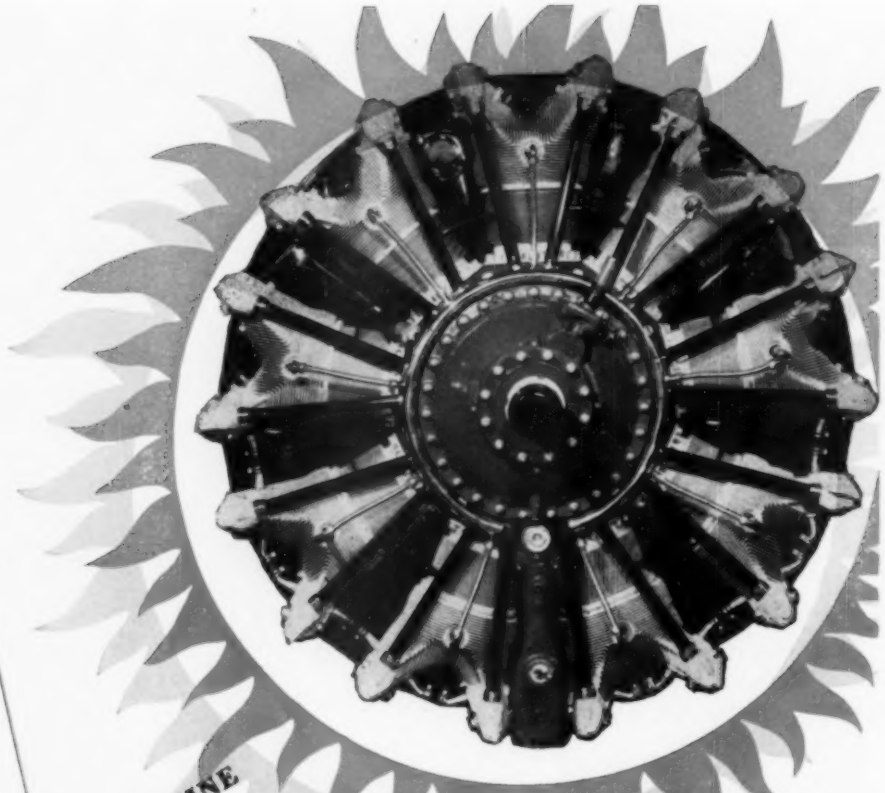

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increase of 10% in the gross weight of an airplane or an airplane-type missile weighing approximately 10,000 lb. results approximately in a 27% longer takeoff run, a 13% decrease in sea level rate of climb, and a 5% reduction in absolute ceiling.

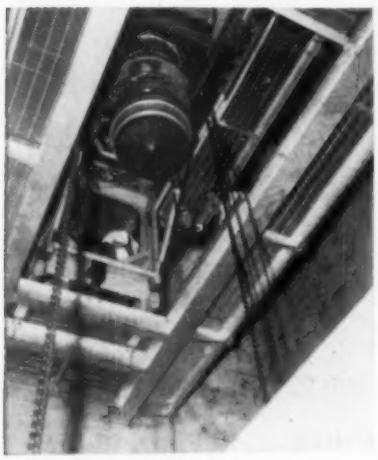
The same 10% weight increase, providing fuel load is constant, results in a reduction in range of 12%.

Altitude Reduction

Referring to a high altitude sounding rocket, Knight pointed out that a 10% increase in structural weight will result in a reduction of about 10% in peak altitude attainable. On the other hand, he said that if structural weight were pared by as much as 50%, enabling propellant content to be increased from 80% to 90% of total rocket weight, peak altitude could be increased by about 85%. Attainment of this ideal design condition represents a real challenge to weights and structures engineers working on preliminary design of rocket missiles, Knight said.

Knight also assigned accuracy requirements for the following parameters: horizontal location of C.G., ±2%; lateral and vertical C. G. positions, ±¼ in. for rocket-boosted aircraft; moment of inertia values, ±5%; inclination of principal axis (product of inertia), ±½ deg.

Weight estimation by weight penalty



Test VTOL Engine

First qualification run on a jet control and propulsion system for the Ryan X-13 VTOL aircraft has been completed in the company's new vertical test cell. The complete powerplant installation, including the systems for control in the vertical attitude and during transition, was operated for 25 hours: five hours in the horizontal position, 15 hours in the vertical position and five more in the horizontal position. Control may be provided through vanes in the tailpipe or by mounting the last segment of the tailpipe on powered gimbals.

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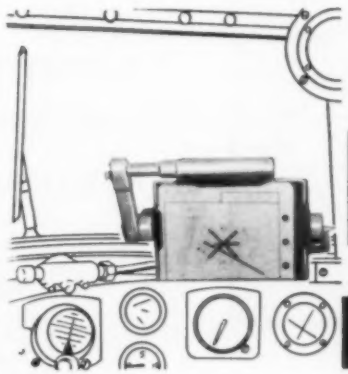

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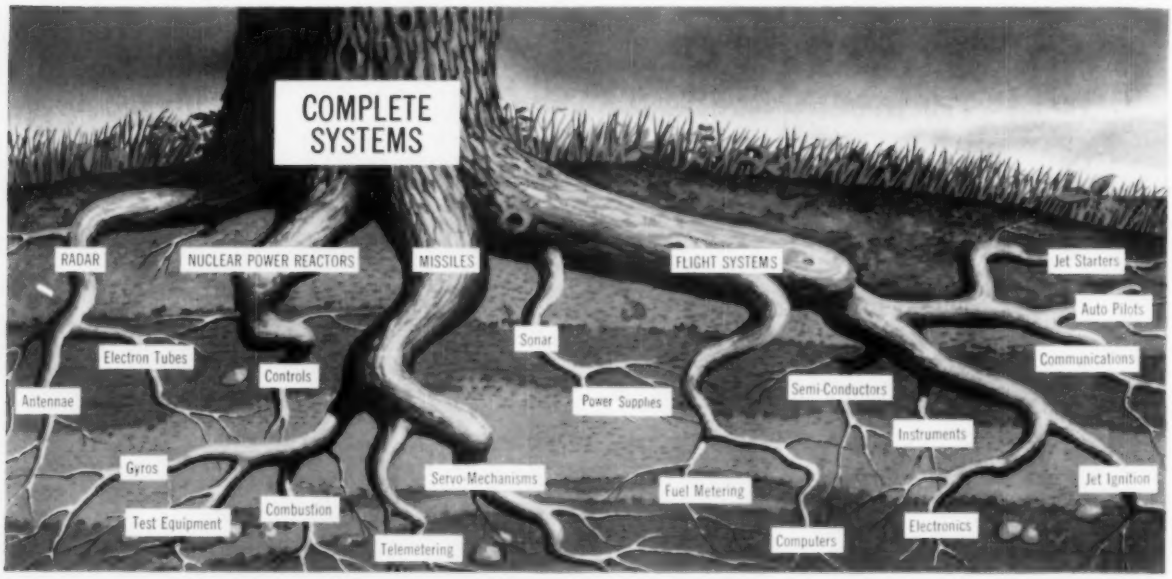

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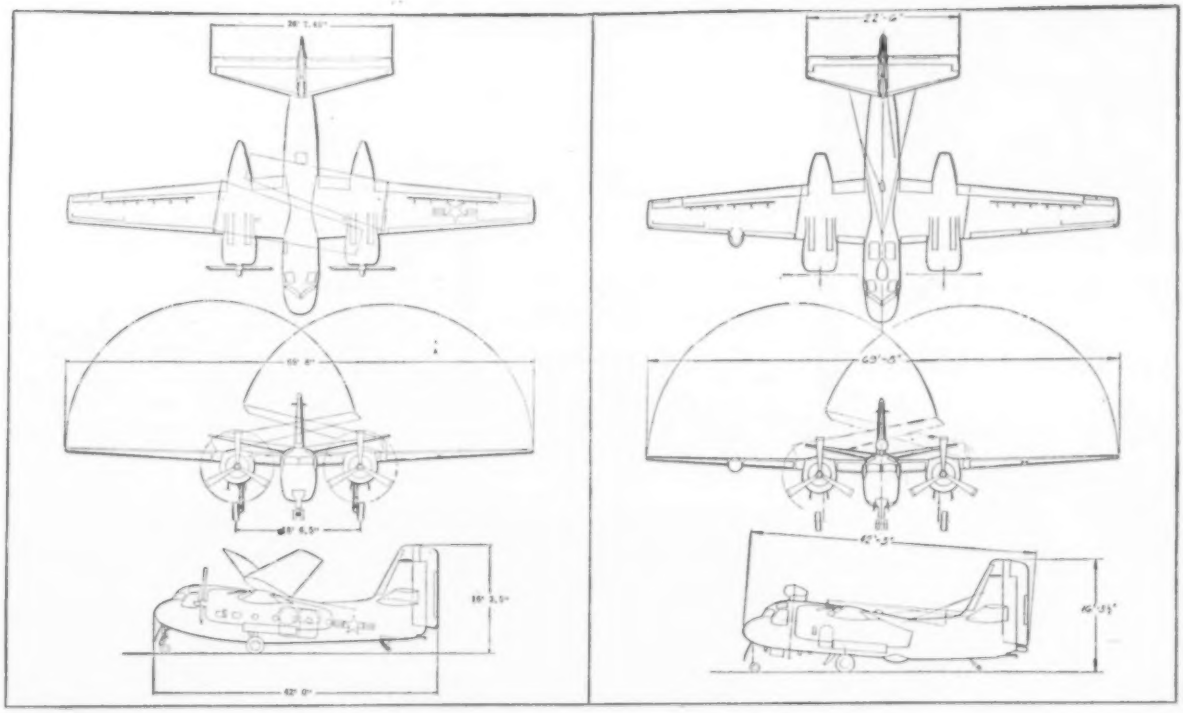


Sub Hunter Into Transport

Grumman's TF-1 utility transport (left) is a conversion of the operational S2F-1 sub hunter-killer (right). Major change was the replacement of the S2F's extensive anti-sub weapon system by either rearward-facing seats or cargo racks. TF-1 also has modified fuselage shape and four feet more span on the horizontal tail. TF-1s have been assigned to Fleet Logistic Air Wings as carrier re-supply aircraft, replacing old Grumman TBF single-engine torpedo bombers.

concept for preliminary design was discussed by R. L. Hammitt, Chance Vought Aircraft, Inc. This concept permits a detailed weight analysis of special design features as well as for the basic structure. This approach also allows the evaluation of weight effects of temperature and stiffness requirements, material types and structural arrangement.

Hammitt defined basic structural weight as the optimum structural material required to form the actual contour and to resist the overall critical applied loads, excluding local loads. This weight is determined by analytical methods.

Weight penalties for special design features such as landing gear, production joints, control surfaces, high lift devices, etc., are determined by empirical methods, Knight said.

Suggestions for possible weight savings in landing gear strut design were offered by V. N. Forsgren, weights group supervisor with Bendix Aviation Corp.'s Bendix Products Division. Forsgren said external lugs should be grouped to facilitate machining, and slightly additional fork thickness should be allowed, instead of greater width, to obtain lighter fork sections.

He also pointed out that the airframe builder should place more reliance on a strut builder's greater design experience to produce the lightest strut configuration.

Weight savings can be realized by the elimination, where possible, of the compression mechanism for shrinking the strut for retraction, Forsgren said.

Use of high speed digital computers to solve wing structural weight problems was outlined by Dr. H. H. Dixon, Douglas Aircraft Co., Santa Monica. This technique, Dixon said, allows a detailed weight analysis of the wing structural box, including the combined effects of shear and bending occurring in multiple loading conditions.

Without the use of high speed digital computers, he said, the scope of this type of investigation would not be feasible.

Used on the DC-8 jet transport design, the computer analysis permitted a rapid evaluation of the necessary compromise between structural weight and aerodynamic characteristics of the wing, Dixon said.

The need and opportunities for graduate engineers in the field of weight control for the specific duties of weight research and development, weight analysis, and project weight supervision was stressed by O. A. Kelley, Jr., project weight control engineer, Chance Vought Aircraft, Inc. He emphasized that weight control engineering should be promoted and publicized in the colleges as a special field.

Convair Dedicates Model Towing Basin

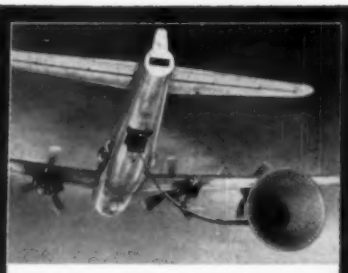
San Diego—Convair Division, General Dynamics Corp., recently dedicated a 300-ft. model towing basin section of its proposed $800,000 hydrodynamics laboratory.

The present unit will accommodate models up to 8 ft. in span, which can be towed by the electric-powered carriage at speeds up to 100 ft./sec.

When completed, the facility will have 700 ft. of towing basin with a 100 ft. by 100 ft. turning section in the center where artificial waves and mixed sea conditions can be created.

Stainless Use to Grow In Supersonic Aircraft

At least 50% of future supersonic aircraft and engines will be fabricated of stainless steel, Republic Steel Corp. predicts. To meet increasing demands for the metal, the company recently increased its capacity 18%. Last year



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To handle adequately the heats generated by skin friction at 1,500 mph., Republic recommends Type 301 stainless containing 17% chromium and 7% nickel. For jet engine applications, Type 410 is useful to 800 deg., Type 321 or Type 347 to 1,400 deg. Above 1,400 deg., Type 310 is recommended.

Portland Copper to Build GE Assemblies

Afterburner and flameholder assemblies for the General Electric J79 will be built by Portland Copper & Tank Works, Inc., South Portland, Me., which did development work. Production contract totals $3 million.

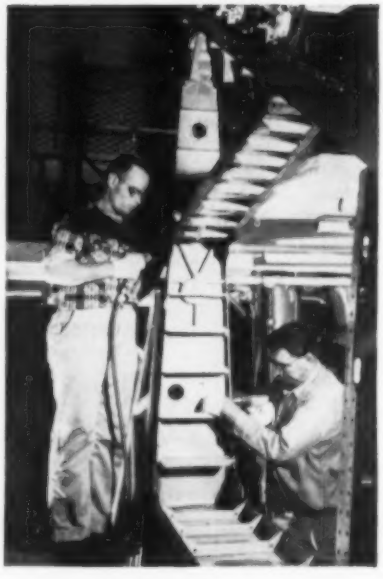
Lockheed Develops Test For F-104 Tail Surfaces

A cheap optic-geometric method of measuring control surface response has been developed by Lockheed for checking the F-104A tail surfaces without expensive test sets.

The method consists of placing a large mirror outside the hangar door in a position to reflect sunlight onto a small mirror attached to the flying tail. Movement of the light spot reflected from the small mirror to the hangar wall can be measured and translated to show the angular deflection of the surface. At the distance from the wall used in Lockheed's tests, a deflection of one degree will move the light spot 25 inches. Deflections as small as three minutes of arc can be measured.

F-102A Bulkhead, Wing Spar Forgings Assembled

Fuselage bulkheads (above) and wing spars (right) for F-102A all-weather jet interceptors are assembled in San Diego, Calif., plant of the Convair Division of General Dynamics Corp. A total of eight parts for the delta-wing F-102A supersonic interceptor are made from heavy press forgings manufactured by the Wyman-Gordon Co. and the Aluminum Co. of America. Early F-102As used blocker forgings until heavy press forgings were available. These giant forgings reportedly save 273 parts and 3,200 rivets and more than 100 pounds of weight in the F-102A. Convair plans to use 18 heavy press forgings in the new, faster version of the F-102A, the F-102B.



Judge a Product by its Users

Newest Navy supersonic fighter is the slim, trim Chance Vought F8U-1 Crusader. In keeping with the F8U-1's advanced design is its use of Aeroquip 601 Lightweight Engine Hose for oil, utility and power control systems; and 617 Lightweight Air Frame Hose for suction lines.

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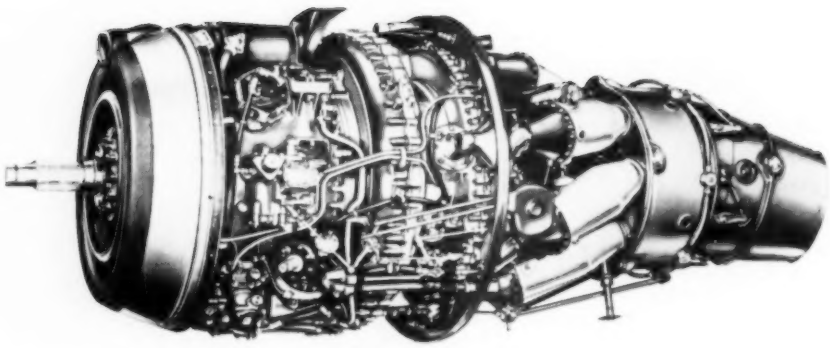

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Supermarine N.113 Carrier Trials

Vickers Supermarine N.113 jet fighter, designed to carry an atom bomb, is about to touch down on the carrier HMS Ark Royal (above) on its initial carrier trials. Powered by two Rolls-Royce Avon engines, the British Navy fighter is about to engage arrester gear (above right). Engines are run up (right) while Supermarine is on the Ark Royal's steam catapult. Trials were completed successfully. Prior to the carrier qualification trials, the aircraft was tested at the Royal Aircraft Establishment. Its arrester gear was initially tested there (below). The aircraft with its hook lowered was taxiied at increasing speeds into the arrester wires. Deceleration was recorded and strain gages measuring the forces to which the arresting wires are subjected.

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AVIATION

For over 20 years Titeflex has stayed in the lead as a foremost maker of flexible metal hose, bendable metal pipe, ignition harnesses and other aviation engine and airplane components. Today—more than ever—we have the experience and physical resources to help you solve *any* aviation conveying problem.

ALL Titeflex Aviation Products MUST Set Highest Known Standards. Quality control is not just

*Du Pont trademark for its tetrafluoroethylene resin

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1. TITEFLEX manufactures flexible hose, made of Du Pont TEFLON, *from start to finish*—makes the innercore, makes and fits the couplings and metal braid.
2. When called for, TITEFLEX supplies both mechanical and swaged fittings for on-the-spot assembly.
3. TITEFLEX Lightweight Flexible Hose measures on *all* counts up to MIL-H-5511 specifications.

OTHER TITEFLEX PRODUCTS

Quick-Seal Couplings | Flexible Metal Hose | Precision Bellows | Ignition Harnesses

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517 Hendee Street, Springfield, Mass.

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- ☐ Titeflex Flexible Metal Hose
- ☐ Titeflex Bendable All-Metal Pipe
- ☐ Titeflex Ignition Harnesses

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FLEXIBLE HOSE AND ACCESSORIES

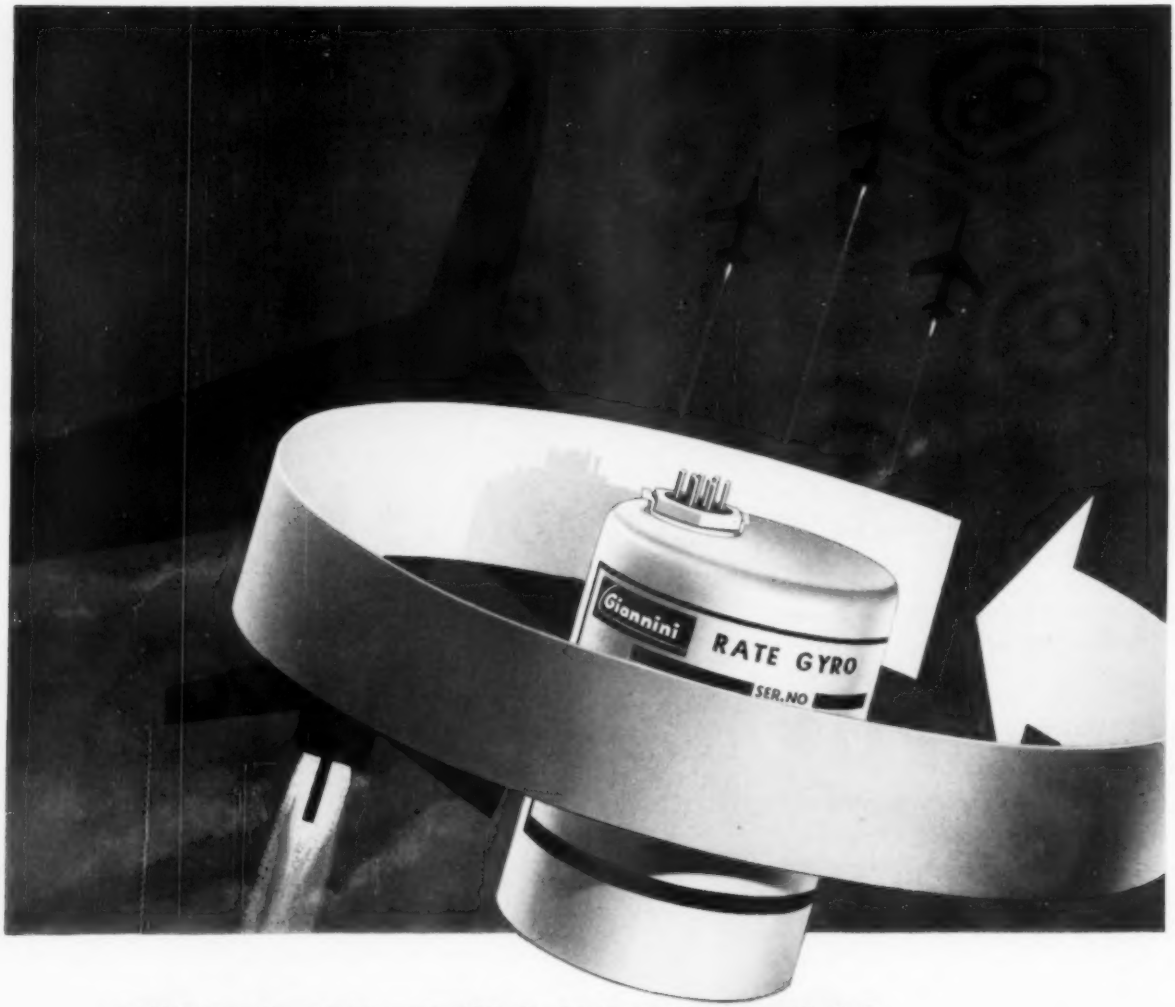
a phrase at Titeflex—it's a "way of life" on which the life of others often depends. If your aircraft conveying problems have become complicated by the extra stresses of jet-age temperatures, pressures and vibration, we have the manpower skills and every other facility to assist you. The same applies with equal force if your operations are still largely confined to reciprocal engines. For more information of your choice, just fill in and mail coupon at left.

Now . . . TITEFLEX Helps Outwit Jet-Age Stresses with Lightweight Flexible Hose made of Du Pont TEFLON* Only Titeflex offers complete manufacturing facilities under unified control with a combination of Teflon hose, metal hose, rigid and bent pipe and components that may enter into the engine system. If your conveying problems are now complicated by higher temperatures and pressures . . . if your assemblies are too bulky, heavy or turning obsolete . . . if you are, in short, looking for the *one* best solution to these tricky problems—you need this *new type* chemically inert hose with an innercore of tough, resilient TEFLON . . . and reinforced with Titeflex metal braid.

OPERATING CHARACTERISTICS OF NEW LIGHTWEIGHT HOSE

- Functions fully in a temperature range of −100°F. to 500°F.
- Withstands pressures from 600 psi to 3000 psi (1¼" to ¼" hose).
- Chemically inert to synthetic lubricants, hydraulic fluids.
- Will not crack or chip; will not cause lines to clog.
- Sizes ⅛" to 1¼", with or without standard fittings.

Titeflex



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Thirty day delivery for the precision Giannini Model 36128 Rate Gyro is Real News!

This is the instrument that made Giannini *First Source* for rate gyros on the Navy's newest and fastest supersonic day fighter, and is standard equipment on many other high performance aircraft and missiles. A carefully planned production schedule based on confidence in the future of this proven instrument permits the unusually short lead time of only *one month* for delivery of the complex Model 36128.

This rugged (40g shock!) instrument is available in standard ranges from ±15°/sec to ±200°/sec. Electrical output proportional to rate is provided by a precision potentiometer which can supply high level output up to 70v requiring no amplification for most applications, and no demodulation where a dc signal is desired. Linearity is 1.5% or better. This small, 2-inch gyro can be obtained in a special, ruggedized version capable of withstanding shock up to 100g! Complete specifications and quotations are available at Giannini Sales Offices. Write for Bulletin 36128.

Giannini
Standard Model 36128

RATE GYRO

Application:
Flight Telemetering & Control,
Guided Missile & Aircraft

Features:
Ranges from ±15°/sec to ±200°/sec
Precision potentiometer output to 70V!
Linearity 1.5% or better
115V or 200V 3-phase 400 cps rotor
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Predictions for Record Electronics Sales Upheld by Financial Reports

By Philip J. Klass

Mushrooming sales and profits reported by a number of avionics-electronics manufacturers on 1955 and first-quarter 1956 operations lend support to the predictions by officials of Radio Corporation of America and Hoffman Electronics Corp. that their sales will double in the next five to 10 years. For example:

- **Hoffman Electronics Corp.** reported first quarter profits up 51% from last year.
- **Servo Corporation of America** reported 1955 profits before taxes up 69%.
- **American Bosch Arma Corp.** first quarter sales and profits were 28% and 25%, respectively, above last year's first three months.
- **Radio Corporation of America** showed 7% first quarter gain with a modest increase in profits.

Hoffman Electronics

Hoffman, which is producing airborne Tacan sets and test equipment, and APG-30 airborne range-only radars, reported its first quarter sales reached $12,155,019, 35% over 1955's first quarter. Net profit after Federal taxes was $467,994, or 64 cents per share on 726,542 shares outstanding. This is a 51% increase over 1955's first quarter.

Company backlog is approximately $35 million, a figure expected to increase "substantially" in the next few months, according to H. L. Hoffman, president. Present military backlog, covering 11 major production contracts and 22 research and development projects, represents 18-month productivity at present levels.

The firm, which also is active in forward scatter communications and the production of single sideband converters for the Military Services, reported that "some of (its) most exciting development work . . . involves the transmission of signals to and from outer space. Although this work is highly classified . . . we are working on projects which encompass communications through the ionosphere and troposphere as well as on satellite projects such as Vanguard."

Hoffman also is working on an airborne system, the ALA-6, which enables an aircraft ECM operator "to determine the direction of intercepted radio or radar signals." The system provides a visual indication on a cathode ray tube of the relative bearing of the radiating source. The company said it holds four R&D countermeasures contracts.

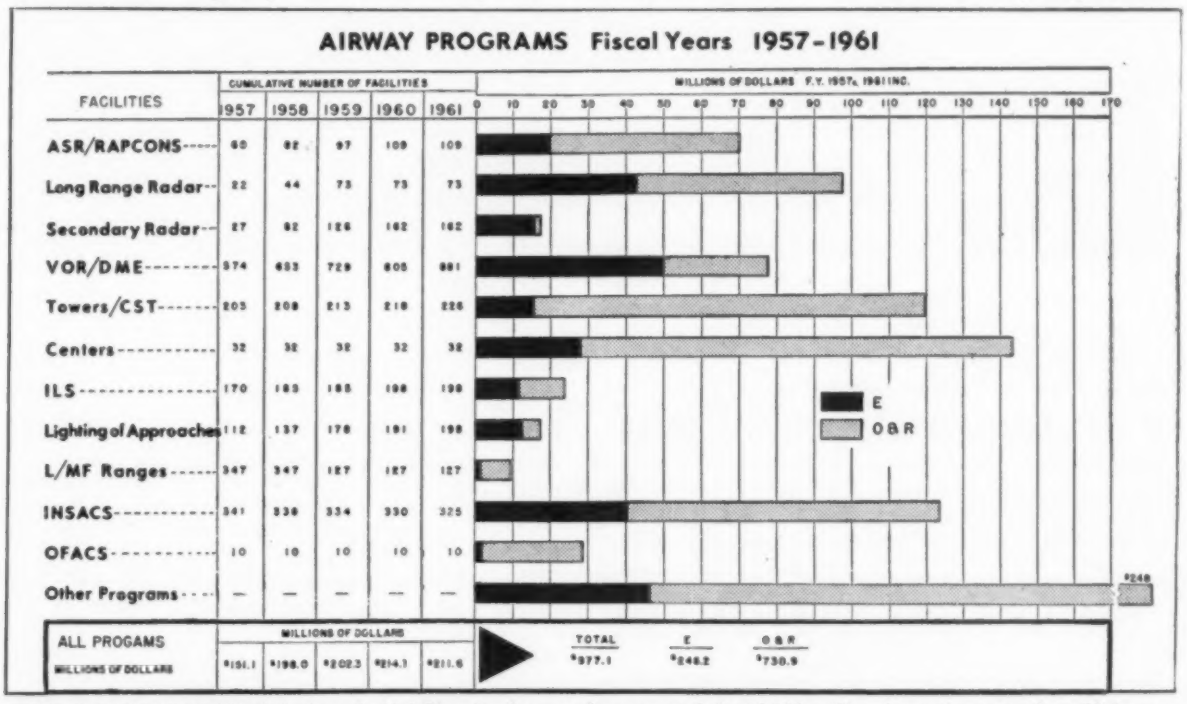
The firm also noted that it is developing a "pulse-doppler, moving target radar for guided missile search and track applications. Modifications of the pulse-doppler radar make it possible for the operator to distinguish between an individual, a group of people, as well as moving vehicles. This new radar development offers a wide variety of practical applications in area surveillance for commercial as well as military applications."

Infrared Department

In the field of missile guidance, the company said it is working on projects involving the launching, intermediate, and terminal guidance phases. It recently established a new infrared division in its engineering department.

Pointing out that Hoffman has had a 1,200 percent increase in sales during the last decade, the firm's president said it hopes to double its present volume in the next five years.

The shorter production runs and greater complexity of military equipment indicate that "any company which



FEDERAL AIRWAYS PROGRAM of nearly $1 billion for the next five years includes $246.2 million for equipment and establishments, $730.9 million for operation and regulation. Approximately $60 million is to be spent on 73 long-range and 162 secondary radar installations.

As flight systems have become more complex, speeds higher, space and weight-saving more valuable, the increasing rate of technical progress in the aircraft industry has created a serious problem:

Keeping its products up to top level of operational effectiveness—and in the air—has become a major responsibility of the prime contractor.

Martin has been working on that problem for many years; and the result is a new kind of service organization and systems method which now provides for the maintenance of all Martin products—from the company's assembly lines to operational flight lines anywhere in the world—at peak effectiveness and with maximum availability.

It is service on a *systems* basis, and already it's setting a new pace in the industry.

MARTIN

hopes to maintain the same volume in 1957 will need three times the engineering complement that was required in 1950," Hoffman said.

In recognition of this trend, the company plans to construct a new engineering building to provide enough space "to triple our engineering force within the next 18 months."

Servo Corp.

Servo Corporation of America, East Coast designer and manufacturer of servo, infrared, communicatoin and navigation instruments and systems, reported 1955 sales of $4,134,000, an increase of 18% over 1954. Net profit before taxes, $552,966, was up 69% over 1954. Net earnings per share, based on 494,791 outstanding, were 55 cents, up 83% from 1954 and up 550% from 1953.

At the close of 1955, Servo's current assets were $2.6 million, an increase of 70% over 1954. Working capital reached $1.4 million, a 450% increase.

American Bosch Arma

Snapping back quickly from the effects of its recent strike, American Bosch Arma Corp. reported first quarter sales of $25,170,749, up 28% from 1955's first three months. This, coupled with special tax credits in the amount of $214,070 produced a net income after taxes of $1,039,860, up 25% from 1955.

Earnings per share, on 1,740,037 outstanding, amounted to 58 cents, up 29% from last year. The company declared a 25 cent dividend on April 12.

For the full year of 1955, the firm reported its profits reached $3,383,568, an increase of 32% over 1954, despite a 1% drop in gross sales which ran $73,805,025.

The company, which holds sizeable production contracts for the MD-9 fire control system used to defend the B-52, and is active in the inertial guidance field, received a $25 million boost in backlog during the first quarter of 1956 for a total of $195 million. This compared to an $86 million backlog at the start of 1955.

RCA

Radio Corporation of America, which last year joined the 28 U. S. companies that gross more than a billion dollars annually, reported first quarter sales of $274,848,000 a 7% increase over 1955's first three months. Profits were $23,395,000 before taxes, $12,727,000 after taxes, roughly 1% above the same 1955 quarter. Earnings per common share for the first quarter were 85 cents, versus 84 cents for last year.

RCA predicted its 1956 deliveries to the Government will run close to $230 million. The company said its backlog of Government orders on April 1 was $265 million.

Chairman of the Board David Sarnoff predicted the electronics industry will double its present $11 billion business by the end of the next decade and RCA's business will exceed $2 billion.

Consolidated Electrodynamics

A West Coast instrument manufacturer, Consolidated Electrodynamics Corp., showed a 9½% increase in sales over 1954 with a year-end total of $17,124,429. Net earnings after taxes were $803,696, approximately 5% below 1954, while per share earnings were 85 cents, approximately 10% under last year's figure. The company has 943,559 shares outstanding, an increase of approximately 6% over the previous year.

Lower earnings were attributed to higher research and engineering costs and increased competition. However, net earnings for the last six months of the year were 54 cents per share, the highest for any six-month period.

Thomas A. Edison

An East Coast aircraft instrumentation maker, Thomas A. Edison, Inc., reported first-quarter sales of $9,889,486, an increase of 11% over last year's first quarter. Profits after taxes were $382,575, up 19% over last year. Per share earnings were 71 cents on 504,164

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★ Lever action design

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GENERAL ELECTRIC

shares outstanding, representing a 15% increase over 1955.

Company president Henry G. Riter III said new orders received during the first quarter of 1956 exceeded by 26% those obtained during the company's best previous year—1953.

General Controls

A West Coast servo system manufacturer, General Controls Co., reported first quarter sales of $7,310,548, up 38% over last year's first three months. Profits for the same period were $354,889, an increase of 17% over the previous year. Per share earnings, after preferred stock dividends, were 41 cents on 768,425 outstanding, about 5% under the 1955 figure when there were 661,369 shares outstanding.

The company reported its 1955 sales were $27,311,700, a 43% increase over 1954. Net profits after taxes were $1,455,495, up 35% from 1954. Earnings per share amounted to $1.70, with dividends of 85 cents per share.

Airborne Instruments

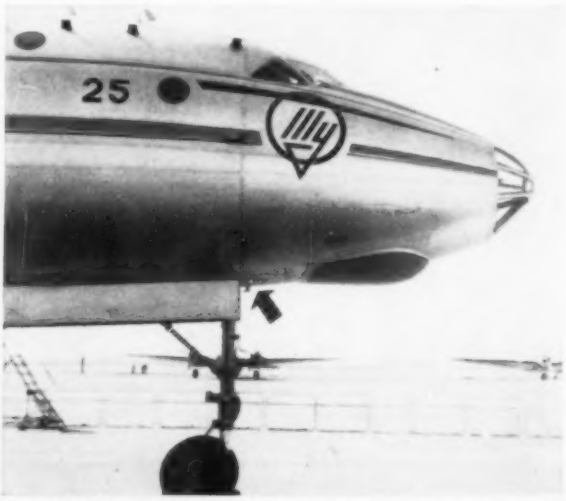
Airborne Instruments Laboratory reported 1955 earnings after taxes of $568,265, approximately a 145% increase over 1954. Only about $375,000 of this figure represents earnings on 1955 sales, the rest being income earned in previous years reported for 1955 because of accepted accounting procedures. However, even that figure is a 60% increase over 1954. This was achieved with sales of $9,276,733, approximately 11% under 1954.

Per share earnings on 197,662 shares were $2.87, compared with $1.44 on 188,150 shares in 1954. AIL President H. R. Skifter said, however, that 1956 earnings may not be as large as those of 1955. AIL backlog as of March 31 was $7.1 million, up 18% from the previous year's figure.

Tu-104 Antennas Are Avionic Clues

RUSSIAN TU-104 mounts large array of antennas, some novel, many conventional. Radar (1) is military bombing-navigation type. Belly mounting will limit its civil usefulness for storm avoidance because of limited upward coverage. Stub antennas (2) for VHF communications and long-wire antenna (3) for HF communications appear conventional. Photo right shows unfamiliar design which appears to be a "Beverage" type antenna, possibly for use as HF direction finder or HF communications standby.

RAM'S HORN antenna, wrapped around leading edge of fin (arrow) probably serves 100 mc. omnirange and ILS localizer receivers.



FLUSH-MOUNTED cone-fed antenna may serve microwave radio/radar altimeter, or could be for countermeasures receiver.

LOOK

at these facilities facts...

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There's a mighty good reason why many leading producers of aircraft engines and air frames see Foote Bros. *first* for precision gearing, power transmissions and mechanical actuators. It's because Foote Bros. offers a wealth of experience in design and production engineering and unmatched facilities for precision production. If you've never taken advantage of this unique combination, we would like to send you our newly-prepared booklet describing in detail the vast resources available and *ready* to serve your power transmission needs. Write for your FREE copy of the Foote Bros. facts on facilities today . . . it has important information you'll want to have on hand!

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Precision lubrication of tiny bearings assures dependable operation of G-E aircraft motors

The drop of oil on the hypodermic needle above could represent the difference between aircraft motor failure and dependable operation. That's why skilled G-E aircraft motor craftsmen make sure tiny ball bearings on G-E aircraft motors are lubricated with just the right amount of oil—*right to the last drop.*

These special lubrication methods are guided by temperatures involved in the motor's final application. For example, a special lubricant in just the right amount must be used in bearings where the motor will have to work at 165 F. At this temperature ordinary lubricant tends to thin and break down. G-E aircraft motor bearings are specially lubricated for frigid temperatures, too. At lower temperatures lubricants tend to stiffen, and too much lubricant in the bearing could prevent the motor from starting.

Special lubrication is just one of the many extra design features available on G-E aircraft motors. Others include Mylar* insulation, newly developed Alkanext wire, nickel finish, stainless steel shaft, unusual protection against radio interference.

Superior design is just a part of the complete G-E story on aircraft motors. Experienced application engineers, excellent testing laboratories, and modern manufacturing facilities all add up to on-time delivery of the right G-E aircraft motors for your application.

FOR PROMPT ATTENTION, contact your local G-E Apparatus Sales Office early in your planning. Or write for Bulletin GEA-6433 to Section 634-1, General Electric Co., Schenectady 5, New York.

*DuPont trademark for polyester film. †Trademark registration applied for by the General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

U.S.S. SARATOGA, (CVA 60), Navy's most powerful aircraft carrier, has more than four acres of flight deck, two acres of hangar area.

Saratoga Has Novel UHF "Gun Tubs"

Recently commissioned 60,000 ton U.S.S. Saratoga carries the Navy's newest avionics equipment, including Tacan and a novel UHF radio antenna array.

To avoid interference from super-structure, and provide full 360 degree UHF radio communications coverage to aircraft and other ships, the Saratoga mounts antenna arrays in "gun tubs" at each corner of flight deck. (See below.)

The Tacan antenna (below, right), which transmits bearing and distance information to all aircraft within a 200-mile radius, sits atop the Saratoga's tallest mast. Underneath are four radar antennas, including surveillance, fire-control, and height-finder.

Tacan and UHF equipment were designed by Federal Telecommunications Laboratory.

UHF radio antennas, located at each corner of the deck, give 360 degree coverage.

TACAN ANTENNA, resembling an oil drum, perches atop a forest of surveillance, fire control, and height-finder radar antennas, and meteorological paraphernalia.

An example of the

Bendix Red Bank

complete line of high-altitude and missile inverters

As aircraft and missile performance continue to step up, Bendix Red Bank designers continue to lead the field in developing new, high-performance inverters and power packages.

We now offer a complete line of inverters from 6 VA to 5,000 VA, including advanced special-application units and missile type power packages like the one shown above.

If we don't have an inverter to meet your specific needs, we'll design one. For full details, write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
† Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, Quebec

INVERTERS — 400-CYCLE OUTPUT

Type	Input		Rated Output			Max. Altitude at Rated Output	Approx. Wt. Lbs.	Designed to Gov't. Part No.
	Volts	Amps.	Volts	Phase	VA Rating			
12128	27.5	1	26	1	6	35,000	2.2	AN3496
12126	27.5	2	26	3	10	35,000	2.3	E1615
32B21	27.5	3	115	1	20	50,000	5	—
MG-93	27.5	12	115/200	1 3	100 100	65,000	10	E5134
MG-54	27.5	22	115/200	1 3	250 250	50,000	17	E5109
12142	27.5	22	115	1 3	250 250	35,000	13	E1617
12143-1	27.5	22	115	3	250	35,000	13	—
12143-2	27.5	22	115	1	250	35,000	13	—
*32B15	27.5	22	115	3	300	50,000	14	—
32E01	27.5	35	115	3	500	50,000	26	AN-3533-1
32E00	27.5	51	115	1 3	500 750	50,000	34	AN-3534-1
MG-65	27.5	52	115/200	1 3	750 750	50,000	35	E52805-2
MG-61	27.5	126	115	1	1750	50,000	54	53C6767
1518	27.5	126	115	1 3	1500 1800	20,000	37	—
32E06	27.5	160	115/200	1 3	2000 2250	50,000	56	E1725
32E03-3	27.5	150	115	1	2500	50,000	58	53B6227
*32E03-8	27.5	160	115	1	2500	50,000	65	53B6227
*MG-77	27.5	150	115/200	3	2500	50,000	65	—
*32B49	27.5	160	115/200	1 3	2500 2500	50,000	65	E54807
MG-81	27.5	160	115/200	1 3	2500 3000	50,000	61	E1725
MG-95	27.5	160	115/200	1 3	2500 3000	50,000	58	E54807
32E09	27.5	160	115	1 3	2500 3000	50,000	60	—
32B27	27.5	285	115/200	1 3	3500 4000	50,000	76	—

*These inverters have magnetic amplifier "static" type voltage and frequency regulators.
NOTE: D.C. Input Voltage shown is nominal value of 27.5 volts, but all units are designed for 26 to 29 volt operation. Input amperes shown are rated at 27.5 volts input.

Red Bank DIVISION

Bendix AVIATION CORPORATION

Expansions, Changes In Avionics Industry

Sperry Gyroscope Co. will open a new West Coast engineering facility at Sunnyvale, Calif., in the fast-growing avionics community near Stanford University to work in the fields of missile systems, fire control, radar and servo mechanisms. The move follows recent announcement of company plans to build an engineering and flight test facility at Phoenix, Ariz. (AW Jan. 9, p. 34.)

The Sperry Sunnyvale Development Center will be headed by E. B. Hammond, formerly engineering department head for airborne weapon systems. A small nucleus of Sperry engineers will be transferred from the firm's Lake Success, N. Y., headquarters, but the company undoubtedly hopes to build up its staff from West Coast sources.

Other recently announced expansions:

• **Lear, Inc.,** has established two operating companies in Europe. One, a Swiss subsidiary, Lear, S.A., has set up offices, laboratories and shops at Cointrin Aeroport, Geneva. The other, a German subsidiary named Lear Electronic, GmbH, has been set up at Reim, near Munich. William P. Lear, board chairman, moved his residence to Geneva last fall to expedite the European expansion and to look into the possible use of European designs and techniques.

• **Minneapolis-Honeywell** is expanding operations of its Transistor Division and moving the group to the Boston area from its present Minneapolis location. New facilities will include engineering, production, and sales, as well as a new applied research section.

• **Topp Industries, Inc., Los Angeles, and Haller, Raymond & Brown, Inc.,** State College, Pa., will merge. Topp produces airborne instrumentation and air data computers, while Haller, Raymond & Brown specialize in datamation and radar remote indicating systems. Total combined assets will be about $2.7 million.

• **Sylvania Electric Products, Inc.,** has formed a new Applied Research Laboratory as part of its Waltham (Mass.) Laboratories to work in military electronics.

• **Transitron, Inc.,** transistor-semiconductor manufacturer, has moved from New York to a new 100,000 sq ft facility in Manchester, N. H. The firm said it plans to expand its electronics and electro-mechanical activities.

• **Radio Corporation of America** has created a new centralized group to handle all spare parts sales to the mili-

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Gilfillan's advanced, high-powered *GCA Quadradar* is the only 4-in-1 Radar System in operation: final approach; surveillance; height-finding; airport taxi control. Gilfillan specifications called for the ability to withstand extreme weather conditions, and complete conformity to rigid MIL-T-27 requirements. Outstanding transformer dependability is an important reason why Thermador continues to serve Gilfillan and other forefront concerns in the field of electronics where complete reliability is essential.

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Electronics Division, Dept. AW-521

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a division of International Telephone and Telegraph Corporation

tary services, airframe manufacturers, and others using its military equipment. This work previously had been handled by individual RCA departments. Herbert Elwes heads the new RCA Defense Spares Marketing activity.

• **G. S. Marshall Co.**, electronic manufacturers' representative, is building new 7,500 sq. ft. offices at 2065 Huntington Drive, San Marino, Calif.

• **Baird Associates, Inc., and Atomic Instrument Co.**, both of Cambridge, Mass. will merge, providing stockholders approve. Baird is in the field of optical-electronic equipment, while Atomic makes nuclear and electronic instrumentation.

• **Harris-Seybold Co.**, Cleveland, one of nation's major printing equipment makers, has purchased Airtronic Research, Inc., Bethesda, Md., a firm active in the electronic component field.

• **Link Aviation, Inc.**, Binghamton, N. Y., a subsidiary of General Precision Equipment Corp., purchased a controlling interest in Air Trainers, Ltd., Aylesbury, England.

• **Radio Corporation of America** will open a new ferrite development lab at Needham, Mass., in a 20,000 sq. ft. building in the New England Industrial Center.

FILTER CENTER

► **Digital Missile Guidance**—Burroughs Corporation reveals that it is developing and producing prototypes of a digital computer which will be used for guidance of advanced missiles. Burroughs says that computer guidance instructions will be transmitted to a missile through a radio communications system. New computers will employ transistors and magnetic cores.

► **Importance of Noise**—Airborne Instruments Lab, which has introduced a new automatic noise-figure indicator, points out that a degradation of only 1 db. in a radar system's noise figure is the equivalent in performance to wasting one megawatt from a five megawatt transmitter, or carrying 10 to 50 pounds of extra equipment in an aircraft radar to make up for lost performance.

► **Arinc Issues New Spec**—A new specification covering equipment case sizes and racking for airline avionics equipment has been issued by Aeronautical Radio, Inc. Prepared by Arinc's Airlines Electronic Engineering Committee, the new spec (No. 404) is available to non-

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then HELP YOURSELF

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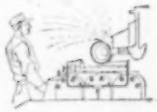
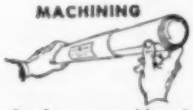


MACHINING



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American Welding has a quarter of a million square feet of floor space that houses the equipment necessary to manufacture production runs of welded rings (made from rectangular bars or special mill shapes) or circular weldments — from 6″ to 96″ in diameter, of ferrous or non-ferrous metal.

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more comfort and safety for

Since pre-World War II days, major production aircraft at Lockheed have been equipped with Lord Dynafocal® Suspension Systems. These produce effective "center-of-gravity" support for piston and turboprop engines, contributing to smoothness and comfort for passengers and crew. While transmitting powerful engine thrust and torque, Lord Dynafocal Mountings isolate engine disturbances, reduce noise, minimize wear to the airframe and improve the overall safety of the craft.

For the finest in aircraft engine mountings, look to Lord—the leader in Engineered Vibration Control and bonded rubber products. For information, call your nearest Lord Field Engineer or the Home Office, Erie, Pennsylvania.

L

ELECTRA (1934):

One of the first all-metal passenger planes. Howard Hughes flew one around the world in 1938.

O

HUDSON (1938):

First American-made plane to fight in World War II. First plane to capture a submarine.

C

LODESTAR (1939):

Fastest pre-war commercial transport. Served during war as troop, cargo and litter carrier.

K

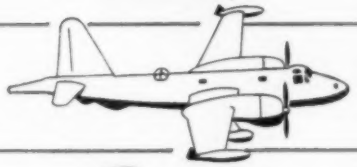
VENTURA (1942):

Versatile hit-and-run bomber of World War II. Backbone of Navy's Pacific air striking force.

H

CONSTELLATION (1943):

First used as high-speed Air Force transport. Now used by airlines all over the world.



E

NEPTUNE (1945):

Navy's first land-based patrol plane carries bombs, torpedoes, mines. Also operates from carriers.

E

SUPER CONSTELLATION (1952):

Ultra-modern passenger plane. Also used as high-altitude radar plane for Air Force and Navy.

D

HERCULES (1953):

Aerial freighter. Turboprop powered for high speeds, can carry 20-ton payload.

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Lord bonded rubber engine mountings are standard on most modern aircraft. Their rugged dependability assures superior vibration isolation throughout a long service life.

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Arinc members at $1.00 per copy. Address: 1700 "K" St. N.W., Washington, D. C.

▶**RTCA Boston Meeting**—The Spring Assembly of the Radio Technical Commission for Aeronautics will be held at the Hotel Statler, Boston, June 5-6. Theme: "Future Use of the Airspace."

▶**Computer Symposium Proceedings**—Proceedings of the Second Annual Computer Applications Symposium, sponsored by the Armour Research Foundation of the Illinois Institute of Technology, are available. The 108-page proceedings, which include transcripts of discussion which followed each paper, are priced at $3. For copies, write: Armour Research Foundation, CAS:2, Technology Center, Chicago 16, Ill. The next annual symposium will be Oct. 9-10 in Chicago.

▶**Lots of Radar**—RCA reports it has now sold nearly 600, or $10 million worth, of its AVQ-10 storm-warning radars to airlines and business aircraft operators. Of this number, roughly half have been delivered, and half of these are installed. At the time RCA and Bendix launched their radar development without firm airline orders, their action was viewed as a calculated gamble. The gamble has paid off for both.

▶**Training Technicians**—Hughes Aircraft will run an electronic technician training program in an effort to ease the shortage. Under the three-year program, which begins in June, 60 men will be given four hours per week of electronics laboratory training, six hours of classroom instruction, and 36 hours/week of on-the-job training. The men will be paid for a 40-hour week.

▶**MIT Summer Course**—The Massachuetts Institute of Technology offers two summer short-courses of possible interest to the avionics industry:

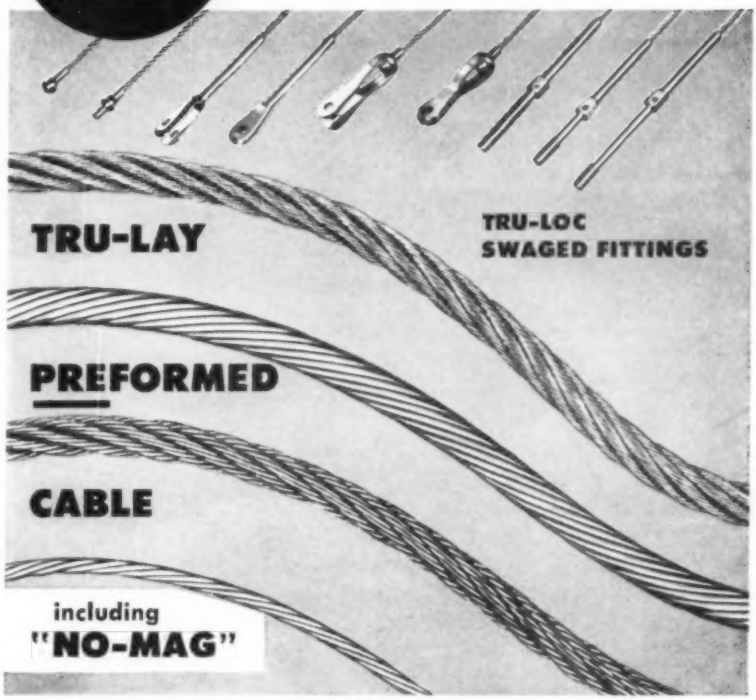
• **"Modern Communications,"** Aug. 20-31 dealing with information theory, coding, noise, and detection. A working knowledge of basic information theory techniques and statistical theory is a prerequisite. Visiting lecturers will include Dr. Claude E. Shannon, Bell Telephone Labs, and Dr. Benoit Mandelbrot, from the University of Geneva, Switzerland.

• **"Analog-Digital Conversion Techniques,"** Aug. 13-17, will be directed toward system and design engineers with a background in electrical engineering, but not necessarily experienced in digital data processes.

Full details and application blanks on either course can be obtained by writing MIT's Summer Session Office, Room 7-103, Cambridge 39, Mass.

ACCO products

TRU-LAY Cables
TRU-LOC Fittings



Solving Aircraft Design Problems...

is an old story to ACCO. The originators of preformed cable and swaged terminals for aircraft use, ACCO engineers have now introduced new non-magnetic aircraft cables. The complete line of ACCO cables and fittings now includes . . .

New "No-Mag" Cable — ends instrument interference

New "NO-MAG" Aircraft Cables are made from Type 305 stainless steel. Their advantages include:

• Remain non-magnetic even after severe cold working—eliminate instrument interference through cable magnetism.

• Better corrosion-resistance properties than standard stainless steel cables.

• Thermal expansion characteristics are much closer than standard cable to characteristics of aluminum alloys used in aircraft—this simplifies maintaining cable tension under changing temperatures.

• High fatigue and abrasion resistance.

• Preformed construction.

TRU-LAY Cable Provided in all standard stainless and carbon steels in a complete range of sizes and constructions. Because it is preformed it

• Can be cut without seizing.

• Is easier to handle—less tendency to loop or kink.

• Can be installed in less time.

• Is free of tendency to rotate—runs true over sheaves or pulleys—is easier on pulleys.

• Has greatest resistance to bending fatigue—gives longer service.

TRU-LOC Swaged Fittings

• Guaranteed to hold to the rated breaking strength of the cable with which used.

• Eliminate costly, uncertain splicing.

• *"Quickies"*—specially developed double-shank ball-type terminals—make it possible to connect and disconnect control sections in an instant without tools.

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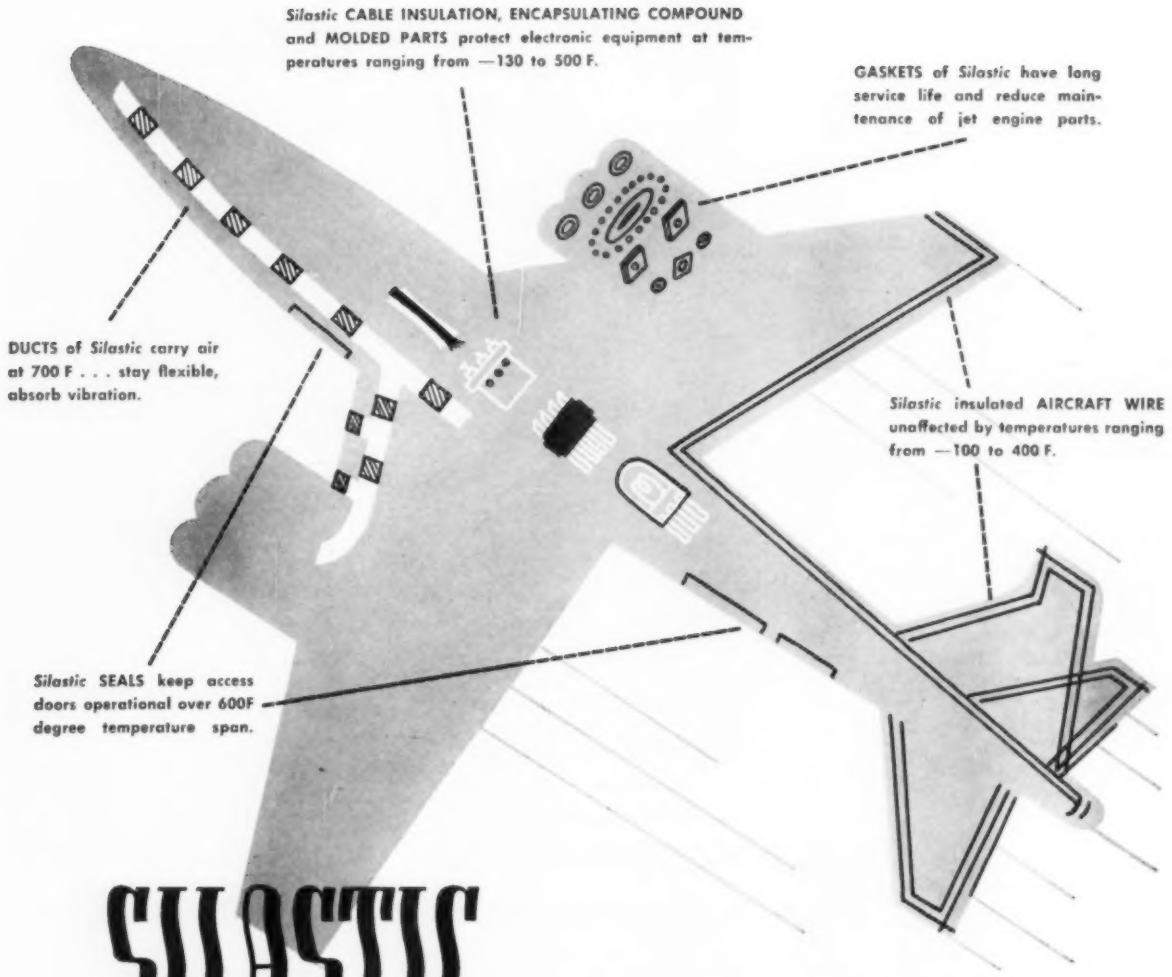
Aircraft Cable • Swaged Fittings


Silastic CABLE INSULATION, ENCAPSULATING COMPOUND and MOLDED PARTS protect electronic equipment at temperatures ranging from —130 to 500 F.
GASKETS of *Silastic* have long service life and reduce maintenance of jet engine parts.
DUCTS of *Silastic* carry air at 700 F . . . stay flexible, absorb vibration.
Silastic insulated AIRCRAFT WIRE unaffected by temperatures ranging from —100 to 400 F.
Silastic SEALS keep access doors operational over 600F degree temperature span.

SILASTIC protects vital aircraft parts . . . keeps them operational at temperature extremes!

Here are the properties that have made it possible to design far superior protection, performance and reliability into key aircraft components . . . with *Silastic**, Dow Corning's silicone rubber:

- Stays elastic from —130 to 500 F
- Keeps its shape and resilience — high resistance to compression set.
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Wherever your designs can be improved by a rubbery material that will *stay* elastic and show no change in physical or dielectric properties at temperature extremes which would quickly destroy ordinary rubbers . . . specify SILASTIC!

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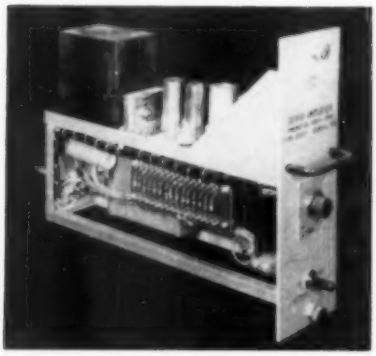
NEW AVIONIC PRODUCTS

Components & Devices

• **Servo amplifiers,** for use with 115 v., 400 cycle two-phase motors. Models 2307 and 2308 have magnetic amplifier output stages, can handle motors rated up to 18 and 10 watts per phase, respectively. Up to four inputs can be totalled



in input summing network and 80 mv. input will produce full output. Models 2309 and 2310 have push-pull vacuum tube output stages for motors rated up to 18 and 10 watts, respectively. Bulletin TDS 23011, Rev. 1, gives application data. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.

• **Subminiature trim potentiometer,** Model 130, has solder-lug type terminals for use with printed wire boards and dip soldering. Pot is screwdriver adjustable over 25 turns, comes in 11 stand-

ard resistances from 10 to 20,000 ohms, with resolutions ranging from 2 to 0.02%. Bulletin 130/6/A gives application data. Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif.

• **Magnetic amplifier relay** has sensitivity of 80 to 100 microwatts, operates over temperature range of −55C to 100C, and has 2 amp. contact. Device reportedly meets MIL-R-5757C and MIL-E-5272A. Relay measures 1¼ in. dia. x 2¾ in. long, weighs 6 oz. Bulletin 562 gives application data. The Liquid-

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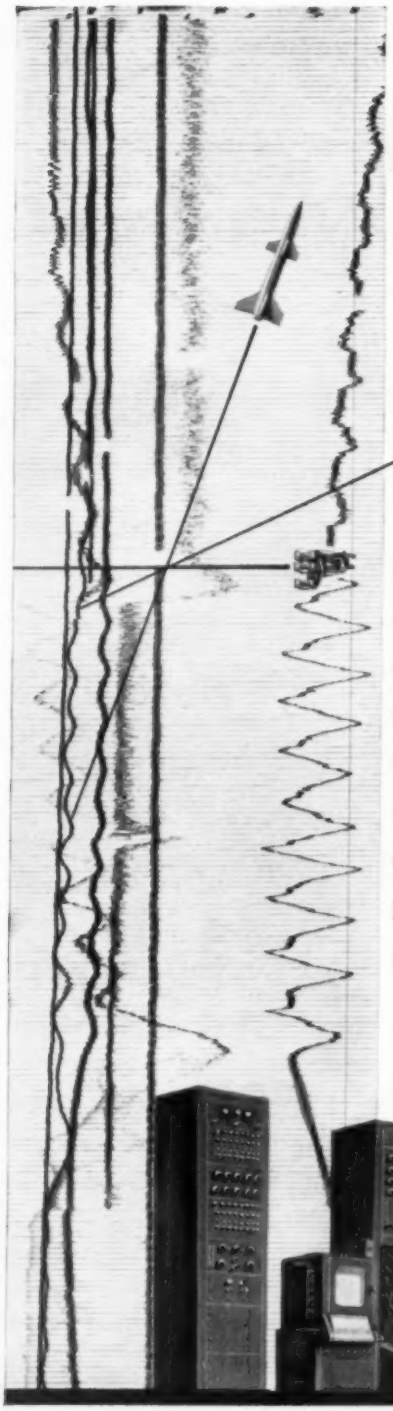

ANALYSTS WANTED

There are more than 100 important projects at Bell Aircraft which have created new openings for analysts in a variety of capacities. These projects are in a dozen different scientific and technical fields and the assignments are of extremely challenging nature. Advanced projects are offering opportunities to qualified engineers for professional achievement with gratifying personal and financial rewards.

DYNAMICIST

— to supervise the work of engineers involved in dynamic problems relating to rocket engines, inertial guidance, servomechanisms for research aircraft and missiles. Problems range from design criteria to analysis and testing.

FLUTTER ANALYST

— to supervise the work of engineers responsible for flutter analysis and testing of research aircraft and missiles. Ability to determine effects of aerodynamics heating and servo systems on the flutter problems is necessary.

ENVIRONMENTAL SPECIALISTS

— to establish environmental, design and test criteria and test methods. Specialists in the field of vibration, shock, acoustics and temperature are required.

NUMERICAL ANALYSTS

— for IBM programming to prepare routines for basic mathematical problems which are combined to provide solutions to recurrent problems in aircraft engineering. Emphasis is placed on determination of methods and analysis of results.

RELIABILITY ENGINEERS

— to analyze and determine the basic cause of failures on servo, propulsion and electronic systems. Requires persons with diversified technical background, strong initiative, for considerable contact and discussion with Project Engineers.

OPERATIONS ANALYSIS

— Application of mathematical and physical concepts to weapons system evaluation studies and system analysis. Background in probability theory and statistical analysis desirable.

• For the career-minded engineer whose interests lie in these categories, contact...

MANAGER,
ENGINEERING PERSONNEL
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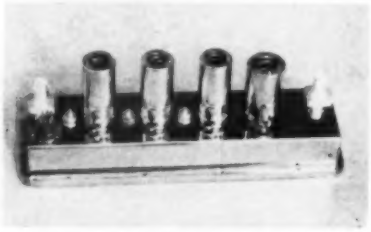
BELL *Aircraft* CORP.
P. O. Box 1 • Buffalo, N. Y.

ometer Corp., Skillman Ave. at 36th St., Long Island City 1, N. Y.

• **Gearless differential,** Model T751, for applications where minimum backlash is needed, uses precision balls instead of conventional planetary gears. Unit comes in servo-motor type case. Sterling Precision Instruments Corp., Instrument Div., 34-17 Lawrence St., Flushing 54, N. Y.

Microwave Devices

• **I-F Pre-amplifier,** Model IF 31, provides 30 db. gain and 1.4 db. noise figure at 30 mc. Unit is available for any

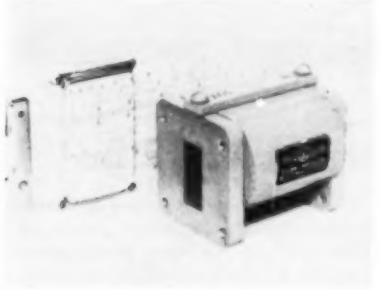


desired bandwidth and center frequency with either single or balanced input. LEL, Inc., 380 Oak St., Copiague, N. Y.

• **Continuous-tuning klystron,** over range of 2.5 to 2.7 kmc., can deliver 15 kw. peak power and 53 db. gain over full band.

Tube efficiency is 40%. Frequency can be changed remotely by cable. General Electric Co., Tube Dept., Schnectady, N. Y.

• **X-band load isolator,** Model X110, weighs only 1 lb., measures only 2 x 2 in. provides 9 db. isolation at 100 kw. peak power over a bandwidth of 8.6 to



9.6 kmc. Litton Industries, Components Div., 336 No. Foothill Road, Beverly Hills, Calif., or 215 So. Fulton Ave., Mt. Vernon, N. Y.

• **Miniature C-band magnetron,** Type BL 206, reportedly will withstand 10,000 G's longitudinally and 1,000 G's laterally. Frequency drift is less than 0.05 mc/Deg. C., weight is 6.5 oz., and dimensions are 1¼ in. dia. x 3⅛ in. high. Set screw provides tuning

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

The news files over the years on the Douglas DC-8 make fascinating reading — the guesses, the conjecture, the estimates, the inferences, the reports from "authoritative sources."

I even found one back in September 1945, that declared the new DC-8 would be a 48-passenger transport, 50 percent faster than the DC-3, with a maximum cruising speed of 270 m.p.h.! The ship, according to the story, would be powered with two liquid-cooled Allisons turning contra-rotating props astern. Who wrote that yarn, I'll never know, as I was in the Navy at the time.

By 1952, a year after initial engineering work actually started, the guesses were nearer the truth. They labeled the Douglas development as Project 1278, declared the jet transport ("familiarly known as the DC-8") would be powered by four jets, carry some 80 passengers and fly about Mach .9. It was noted that the ship probably would have a swept wing, but the story erred in saying that a formal announcement by Douglas could be expected in 60 days.

It was not until a year later that Donald Douglas broke his silence on the jet transport situation.

"I am convinced," he told stockholders, "that we are going to build a jet turbine liner. When that will be is another matter, and I don't know when we will release our DC-8 design to the shop."

At that time it was noted that more than $1,000,000 had been spent on preliminary design phases, and "reliable reports" spoke of a full-scale mockup behind huge curtains at the Santa Monica plant.

Today, three years later, that $250,000 mockup – a carpentry project as fine and precise as the metal to which it will give form – is nearing completion, and the opening chapters in the saga of the DC-8 are known throughout the world.

Even while one of the brightest stars in America's jet transport age is taking form in wood – and without a flying article for demonstration – Douglas has sold 110 DC-8's to 10 airlines on the company's reputation and the specs it has produced on paper.

As amazing as this sounds, it is not surprising. The airlines know Douglas products and Douglas capabilities. Most important, they know Douglas engineering. They're willing to buy, sight unseen – and at $4,500,000 to $5,250,000 per copy – the new, beautiful queen of the airlanes because the men responsible for her are tops in the industry. . . a basic team of 11 men, the same lineup that put Douglas at the top of the piston-powered transport league.

Who are these men who have taken the field again in the jet transport game under "Director of Athletics" Arthur E. Raymond, vice-president-engineering; "Coach" E. F. Burton, Santa Monica Division chief engineer; and "Assistant Coach" Harold W. Adams, chief designer?

They are Ivar L. Shogran, chief project engineer for the DC-8, a veteran of 25 years at Douglas and formerly chief of the power plant section prior to his present assignment; Dr. W. Bailey Oswald, chief of the aerodynamics section since he joined Douglas in 1932; W. W. (Bill) Reaser, chief of the air conditioning section since February 1937.

They are Peter Duyan, Jr., chief of the equipment section since June 1952, a member of the section since 1938; Carl W. Chambers, chief of the hydromechanical section since February 1936; J. A. (Jack) Graves, chief of the interiors section since December 1933.

They are A. E. Farr, since February 1936, chief of the mechanical controls section; Carl A. Weise, chief of the power plant section since 1952, and a member of the section since November 1939; W. W. Jenny who joined the strength section in September 1935, and became its chief in January 1953.

They are Edward Harpoothian, chief of the Douglas structures section since he joined the company in October 1935; and L. S. Mull, chief of the weight control section since December 1938.

Add up the years of experience, the man-hours of hard work represented by this team of section heads, and the answer to the DC-8's phenomenal sales is self-evident.

The airlines have commended this team by buying the luxury jet liner in all confidence before it flies. Whittaker, in offering congratulations, can do no less – for DC-8 success is merely a matter of schedule.

(Advertisement)

HEAT that could buckle an aircraft's skin
The engine compartment of McDonnell Aircraft Corporation's F-101A Voodoo is protected with J-M structural insulation. This new long-range fighter was recently ordered into quantity production by the Air Force.

. . . safely controlled by new Johns-Manville structural insulation

New Problems. The engine compartment of today's jet aircraft is a "hot spot" both literally and figuratively. Not only are engine temperatures rising higher; greater speeds have produced higher air flow velocities and complex pressure problems. These new conditions call for a radical departure in insulation design.

New Answers. Many designers have successfully combatted these engine compartment heat problems with the help of Johns-Manville. In the J-M laboratories new insulating methods have been developed which are adaptable to practically every type of aircraft. Among these is a totally new concept in structural insulation designed especially for engine compartments in the new Century series as well as the latest naval aircraft.

Matchless Experience. In the field of jet aircraft insulation, no other company can match the experience of Johns-Manville insulation scientists. From the very beginning of the jet age they have been working closely with all the major engine and airframe manufacturers. Today they are busy developing new materials in new shapes and sizes for the insulating problems of tomorrow.

Why not put this experience to work for you. Write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville** PRODUCTS FOR THE AVIATION INDUSTRY

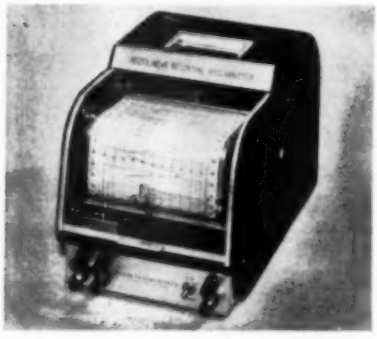
adjustment. Bomac Laboratories, Inc., Beverly, Mass.

• **K$_a$-Band rotary joint,** Model MA-1037, for high power applications to mechanical scanning antennas in the 34.0 to 35.5 kmc. band. Unit reportedly withstands 65 psia. under continuous operating conditions. Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass.

Instrumentation

• **Pulse-width multicoder,** samples and converts low-level signals from 43 or 88 transducers or reference sources into pulse-width modulated signals suitable for recording on Ampex Series 800 airborne tape recorders or similar devices. Sampling rates of 2, 5, 10, or 20 rps. and inputs of 15 or 30 mv. are available. Multicoder is packaged in pressurized cylinder measuring 4½ in. dia. x 13 in. long. Applied Science Corp. of Princeton, P.O. Box 44, Princeton, N. J.

• **Rectilinear recording milliammeter,** employs galvanometer recording element with 2 cps undamped natural frequency operating through a novel pantograph arrangement to give rectilinear



recording on 4½ in. wide chart paper. Galvanometer gives full deflection for 1 ma. input. Device offers choice of 10 chart speeds: ¾, 1½, 3, 6, or 12 in. per minute or per hour. Bulletin DL-R 611 gives full details. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9.

• **Vibration calibrator,** Model 501, for calibrating vibration pick-ups or measuring vibration of non-magnetic metallic surfaces, by comparing with a precise standard displacement. Sensing probe does not require direct contact with vibrating surface, but measures variation in mutual inductance of transducer caused by changes in spacing between surface and probe. Device measures over four decade scale ranges from 20 micro-inches to 0.02 in. full scale. Accuracy, quoted at better than 5% of full scale, reportedly is independent of frequency over range from 10 to 20,000 cycles. ACF Electronics, 800 North Pitt St., Alexandria, Va.

ROLLE COMBINES SHELL AND PERMANENT MOLD

FOR AIRCRAFT DIFFUSER

The problem was finding the one *best* method for casting this aluminum aircraft diffuser. A method that would meet *all* requirements . . . providing the utmost in economy as well as fine surface finish and high dimensional accuracy in the critical vane areas.

Rolle foundry engineers carefully studied the part . . . then recommended semi-permanent mold casting, with a shell core for the vane area.

Using this method, vane thickness is held to within .008" among vanes. Surface finish measures from 60 to 100 micro-inches as compared to 125 to 150 standard with permanent mold alone. Wall thickness is held to within .015". And this better casting actually costs less than it would by any other casting method.

PERTINENT DATA
Permanent mold and shell cast aluminum aircraft part
Alloy 355
Temper T51
Weight 7 pounds, 6 ounces
Zyglo and X-ray inspection to rigid aircraft standards.

Your casting problems, whether they involve sand, permanent mold, shell mold, or investment casting, of aluminum or magnesium—can always be solved quickly and economically if you bring them to Rolle.

FREE 57-Page ENGINEERING MANUAL on designing aluminum and magnesium castings available on letterhead request. Write now for your personal copy.

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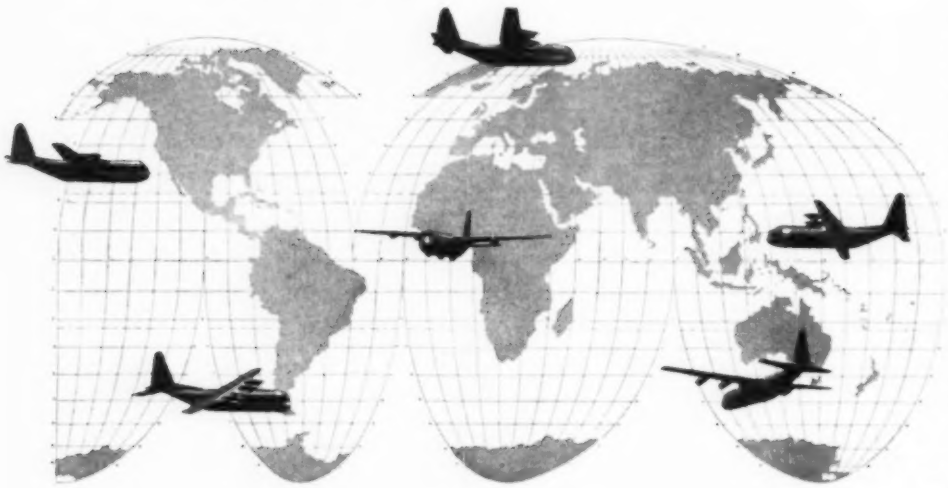
LOGISTICS NEEDS

THE GO-ANYWHERE, HAUL-ANYTHING TRANSPORT–



USAF's C-130 HERCULES

Today America's military services are in the aerial trucking business in a big way transporting men and supplies to bases all over the world.

Their problems and requirements vary. But whether the job is airlifting a division to Japan, airdropping tractors or buildings at Arctic DEWline sites, or rushing missiles and fighter engines to Middle East bases, the need for mobility and versatility has never been so great.

It was for such heavy-duty hauling assignments—*of all kinds*—that America's first propjet combat transport, the Lockheed C-130 Hercules, was designed.

PROPJET SPEED. With its four Allison T56 engines, the Hercules flies *faster, farther, at lower cost* than any previous combat transport.

20-TON PAYLOAD. Carries 40,000-pound load for long distances at high altitudes; with its unique push-button paradrop system, spot-drops 25,000 pounds at *one* location.

FASTER TURN-AROUNDS. Minimum loading and unloading time—fuselage floor is truck-bed height; adjustable tail ramp permits vehicles to drive aboard.

NEW MOBILITY. Takes off at 110,000 pounds in 12 times its own length; lands and takes off on improvised runways.

SIMPLIFIED MAINTENANCE. Multiple use of identical assemblies reduces spare-part requirements; easy accessibility of all components reduces service time.

AN ALL-PURPOSE CARGO, personnel and evacuation transport, the Hercules is now being manufactured in quantity at Air Force Plant No. 6, Marietta, Ga. Initial deliveries are for Tactical Air Command's 18th Air Force.

Specifications

Wing span, 132 feet
Length, 95 feet
Gross weight, 124,000 pounds
Cargo payload, 40,000 pounds
Troop capacity,
92 fully-equipped troops
Horsepower, 15,000
Entire fuselage pressurized
and air-conditioned.

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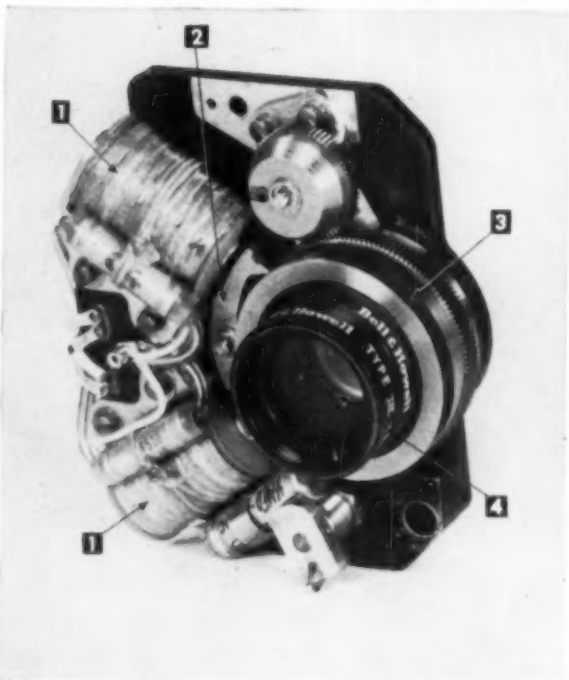
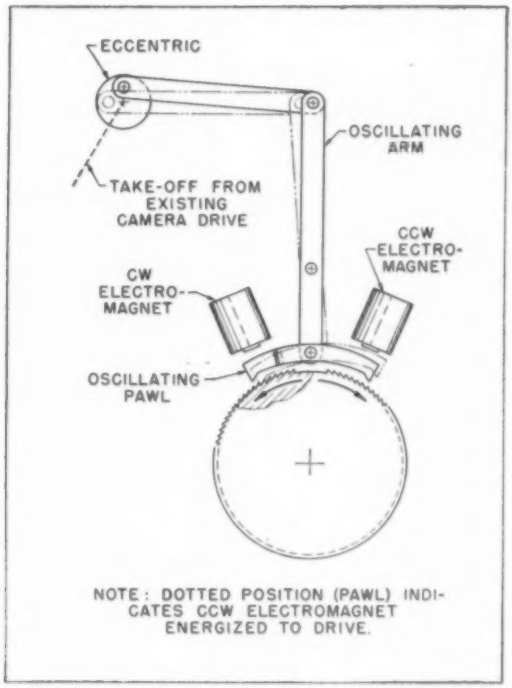
Challenging opportunities in aircraft and nuclear work are available for outstanding scientists and engineers. Inquiries invited.





TWO COILS (1) responding to a built-in exposure system automatically adjust lens aperture of gun camera. A camera motor driven eccentric drives an oscillating arm (drawing), but pawl (2) is held in neutral. If the light value of scene changes, one coil or the other is energized and pawl actuates diaphragm ring (3) to provide new opening for lens (4). System is a first.

Gun Camera Tunes Exposure to Light

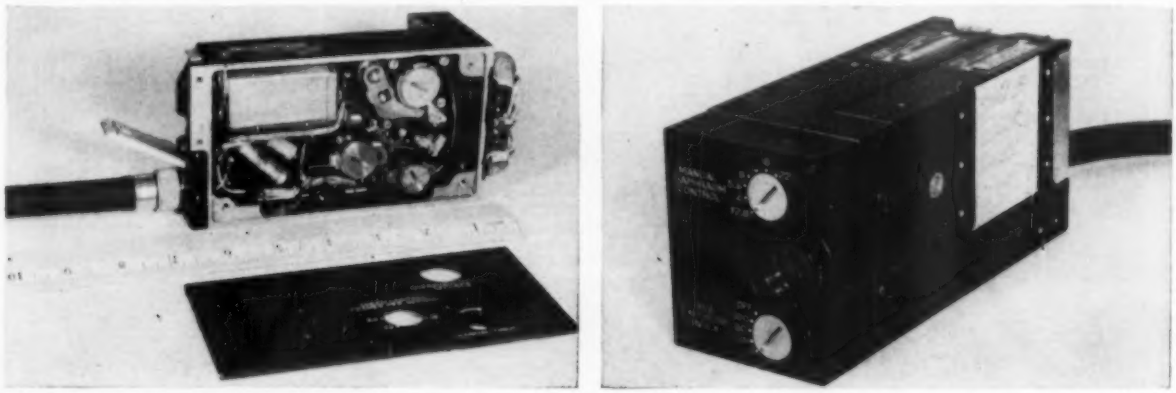
Syosset, N. Y.—A gun camera which rapidly and automatically adjusts its lens opening to within ½ an f. stop of correct exposure in less than a second in most conditions is under evaluation by the Air Force.

Called KB-5, the gun camera has approximately the same volume as the current standard N-9 gun camera and weighs only 1 lb. more when fully loaded. Two KB-5s have been delivered to the Wright Air Development Center by the maker, Fairchild Camera and Instrument Corporation.

Air Force and Fairchild officials are confident that the new camera will allow fighter pilots to bring back a much greater percentage of correctly exposed, useable film than is possible with the N-9 camera. The N-9 has only the settings of "bright," "hazy," or "dull," often too vague and inflexible to cope with drastically changing conditions of fighter combat. One moment the camera may be aimed at the glare of open sky, the next at a dull, shadowy ground object.

First Automatic

The KB-5, which is a new design and not a re-hash of old ones, is the first gun camera to have this self-contained automatic exposure control, Fairchild officials said. This mechanism can adjust the diaphragm through the seven lens openings from f. 2.8 to f. 22 in



LONGITUDINAL VIEW of camera shows intermittently-driven sprocket system, and overall length. Lens can be set manually (right).

ANOTHER BLOWOUT. THAT BLASTED LOCKED WHEEL PROBLEM!
THAT'S THE THIRD ONE THIS WEEK, JIM.
HOW DO YOU ACCOUNT FOR IT, WALT ?
SAME AS THE OTHERS. WHEN YOU COME IN FAST, YOU HAVE NO "FEEL" FOR THE BRAKING ACTION. TOO MUCH BRAKE PRESSURE LOCKS THE WHEEL AND IT BLOWS BEFORE YOU KNOW WHAT'S HAPPENING. THOSE SKIDS OCCUR TOO FAST FOR HUMAN REFLEXES

EXCESSIVE TIRE WEAR... FLAT SPOTTING... BLOWOUTS. IT'S BECOME A BIG HEADACHE WITH THESE SUPERSONIC BABIES, WALT. I'VE BEEN READING ABOUT THIS "HYTROL" ANTI-SKID BRAKING SYSTEM AND ...
YEAH, BUILT BY HYDRO-AIRE. THAT REMINDS ME--THEY'VE INSTALLED "HYTROL" ON ONE OF OUR SHIPS. I'M SCHEDULED TO CHECK IT OUT TOMORROW. WONDER IF THAT'S THE ANSWER.
THE NEXT DAY IN THE OFFICE OF THE CHIEF TEST PILOT
MEET ORV WILKINSON FROM HYDRO-AIRE. HE'LL EXPLAIN HOW "HYTROL" HELPS YOU MAKE SURER, SHORTER LANDINGS IN THAT NEW SHIP.
"HYTROL" SUPPLEMENTS THE REGULAR BRAKING SYSTEM. IT SENSES THE INCIPIENT SKID AND RELEASES THE BRAKE TO PREVENT IT...THEN IT RE-APPLIES BRAKE PRESSURE IN A RAPID "ON-OFF" ACTION, FOUR TIMES A SECOND.

THE BASIC UNIT OF "HYTROL" IS A SKID DETECTOR MOUNTED IN EACH WHEEL. EACH SENSES THE SKID AND TRANSMITS AN ELECTRICALLY CONTROLLED SIGNAL TO A SOLENOID VALVE IN THE BRAKE PRESSURE LINE. FAIL-SAFE ACTION ASSURES BRAKES UNDER ANY CONDITION.
YES, IN TESTS "HYTROL" HAS DECREASED THE LANDING ROLL BY AS MUCH AS 30%. THE PILOT MAY LAND WITH BRAKES FULLY APPLIED AND KEEP FULL PEDAL FORCE.
"HYTROL" PREVENTS BRAKE ENGAGEMENT PRIOR TO TOUCHDOWN AND THE WHEELS WON'T LOCK IF THE PLANE "PORPOISES."
WALT'S BRINGING HER IN NOW, MR. WILKINSON. GOOD LANDING!

I'M SOLD ON "HYTROL", JIM. THAT WAS AS NICE A LANDING AS I'VE EVER EXPERIENCED.
NOT A MARK ON THE TIRES, EITHER. AND NO OVERHEATING OF THE BRAKES. YEP, HYTROL'S THE ANSWER TO LANDING A SUPERSONIC FIGHTER.

Notes on hytrol *the accepted Anti-Skid Braking System*

hytrol Saves Tires: performance records prove savings in tire wear of 30% or more.

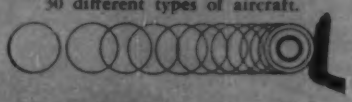
hytrol Eliminates Blow-Outs due to skidding; and a blow-out can cost much more than just a tire!

hytrol Increases Aircraft Utilization: Hytrol users report a marked reduction of unscheduled repairs.

hytrol Minimizes Runway Mishaps due to overshooting, swinging or late take-off rejections — and safety pays off in dollars!

hytrol Controls Bad Runway Conditions ice, rain, slush, snow . . . all of these bad weather "skid gremlins" are controlled by Hytrol's Anti-Skid Action.

hytrol *is Standard Equipment On:* B-47, B-52, A3D, RB-66, RF-84F, F-100, C-130, QF-80, and has been installed on more than 30 different types of aircraft.



For the complete information on Hytrol write to:

HYDRO-AIRE *Inc.*

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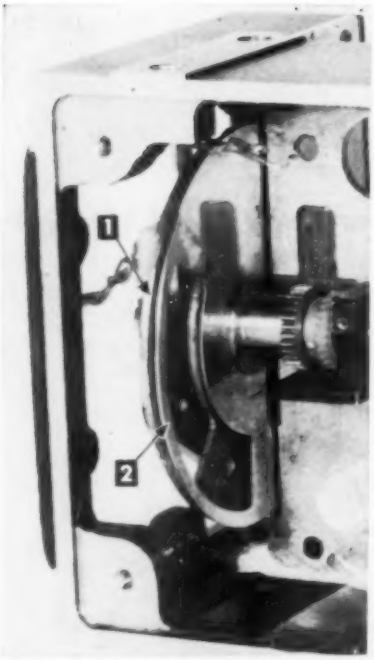

FRONT SHUTTER element (1) is constant speed. Angular opening with rear element (2) is fixed.

1.8 seconds. Shutter speed is constant at 1/250th of a second.

A single lens is used to photograph and to measure light values, eliminating exposure difficulties caused by variation in light transmission qualities possible in a double-lens system, because of the use of filters or because of dirt or oil splattered on the lens. Besides, the single lens has less weight and bulk than a double lens system.

Film advance is accomplished by an intermittently-driven sprocket wheel which remains constantly engaged with the film sprocket holes. Elimination of conventional, easily-bent claws to advance the film precludes the possibility of damaging film sprocket holes, of tearing the film or of misaligning sprocket holes and claws.

A wriggler diaphragm drive system derives power free from a powerful camera drive motor.

This eliminates the conventional and easily stalled, flea-power diaphragm drive motor.

Miniaturized and transistorized, the avionic control system allows the KB-5 to incorporate all these features without appreciable increase in weight or size.

Light in Lens

Here is how Fairchild engineers are able to use a single lens for photographing and light measurement.

Light, after passing through the lens, strikes a rotating shutter blade. Part of the front side is coated with a photoconductive material, to which voltage

GYROS
designed beyond requirements

To give the vital few minutes of service required by a missile, gyros must possess ruggedness and dependability that will give them life of a thousand hours or more. Kearfott Gyros possess this ruggedness and dependability. That is why they are so widely used in other forms of aviation as well as in missiles. Kearfott Vertical Gyros conform to MIL-E-5272 A Procedure 11, parts 1 and 2. Kearfott Free Gyros withstand vibration of 5-500 cps at 5 G's, 5 to 2000 cps at 3 G's and 6 G shock of .015 sec duration. Kearfott has Gyros for every application. Write for technical data.

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A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

BARBER COLMAN

Aircraft Controls

chosen to actuate many accessories on new Lockheed 1049G

Across the oceans of the world and over the domestic routes of America, more and more new Lockheed 1049G Super Constellations are going into service. On these advanced, long-range airliners, 14 Barber-Colman electro-mechanical actuators power various valves, scoops, and other accessory equipment.

ONE OF 14 BARBER-COLMAN ACTUATORS ON SUPER CONSTELLATION

Other Barber-Colman products on the Lockheed 1049G include passenger cabin and flight deck temperature controls, gasoline heater cycling controls, auxiliary ventilating controls, and electric windshield temperature controls.

The complete line of Barber-Colman aircraft controls includes: Actuators; Positioning Controls; Temperature Controls; Small Motors; Valves; Ultra-Sensitive Relays; Thermo-Sensitive Elements. Consult the Barber-Colman engineering sales office nearest you: Los Angeles; Seattle; Baltimore; New York; Montreal; Melbourne.

Barber-Colman Company

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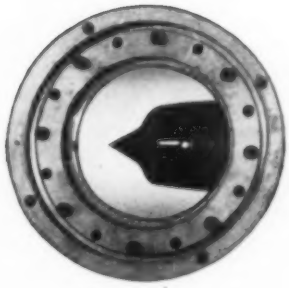
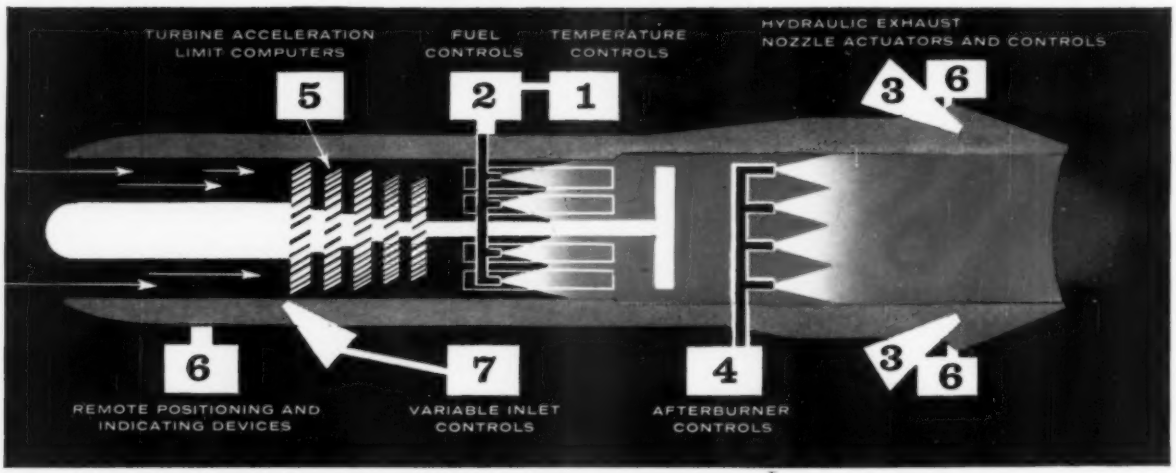
OVERDOORS AND OPERATORS • MOLDED PRODUCTS • METAL CUTTING TOOLS • MACHINE TOOLS • TEXTILE MACHINERY



This is a model of an inlet air diffuser for turbojet engines, mounted in a supersonic wind tunnel. To assure maximum performance, the diffuser must position and maintain the proper shock wave pattern at the engine inlet. This is done by an automatic control which positions the diffuser correctly under all flight conditions. Without this Honeywell control, a supersonic aircraft might never reach design speed.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL

CONTROL SYSTEMS FOR ADVANCED JET ENGINES



With the increasing speed of aircraft it has become more important to integrate power plant controls with the airplane and its mission. For over 10 years Sperry engineers have been actively engaged in developing complete control systems for turboprop, turbojet and ramjet engines. Our Aeronautical Equipment Division will be happy to help solve your engine control problems.

Engineers are required to man various exciting programs in engine control development. Write J. W. Dwyer, 1B5.

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Smaller Size in Cameras

A growing interest by the military in smaller cameras is reflected in two Fairchild projects:

- A thin gun camera in the development stage designed to fit in the ultra-thin wings of supersonic fighters. Scarcely wider than the 16 mm. film it uses, it would have a 100-foot film capacity, not the conventional 50.
- A family of 70 mm. precision IMC (image motion compensation) cameras designated CAX-12 and in production for the Navy. The cameras, which take a 2¼x2¼ picture up to ten frames a second, are miniaturized 9x9 in. cameras, but give all the performance of the larger units.

is applied through two slip rings at the hub of the blade.

The resistance of the material varies with the amount of light striking it as intensity of the light increases, the resistance decreases.

The intensity of the scene light is compared to a reference lamp built into the camera. The reference bulb is a special glow discharge lamp containing neon and traces of other gases. It is operated from a high impedance output to keep it stabilized.

Since the shutter with the photoconductive material rotates at 64 rps., the light sensitive material alternately views the light from the picture-taking lens and the standard lamp 64 times a second.

If light levels are equal, no signals are generated. Should the illumination levels differ, current is sent to one of two coils of an electromechanical amplifier called a wriggler servo, which drives the lens diaphragm to a larger or smaller aperture to match the light level of the standard lamp. The lamp intensity can be varied to meet exposure requirements of ASA (American Standards Association) 12 to ASA 100.

Wriggler Drive System

The wriggler diaphragm drive system, developed by Fairchild technicians, is unique in concept.

An arm is attached to a camera motor driven eccentric at one end and to a pawl at the other. The arm is mounted on a pivot between the eccentric and pawl.

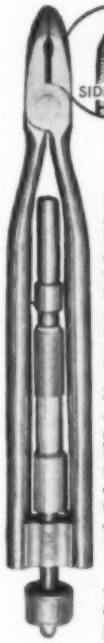
As soon as the motor rotates, the eccentric imparts an oscillating motion to the arm, and therefore to the pawl. At each end of the pawl are the coils used to open or close the diaphragm.

When the closed loop exposure control system is in balance—scene light equal to the level of the standard lamp—the pawl is held in a neutral position by a light-weight spring. When one coil or the other is energized, the pawl end under the coil is lifted magnetically, biasing the pawl. The pawl then actu-

Donut Floats for S-55

Rapidly-inflated donut-type flotation gear (shown above) is being manufactured by Walter Kidde & Co. for Sikorsky S-55 helicopters for emergency water landings in case of engine failure. Air, compressed to 3,000 psi. in a 900 cu./in. fiberglass sphere, is electrically released by the pilot through pneumatic lines to each wheel. At the wheels, the compressed air is discharged through devices called Inflatairs which, through aspiration action, cause the compressed air to force ambient air into the four, rubberized nylon fabric floats. These inflate in 4-5 sec. to an average pressure of 1¼ psi. Special equipment guards against over- or under-inflation and accommodates for temperature extremes. The floats, which permit water taxiing, provide approximately 100% reserve buoyancy with a helicopter weight of 7,200 lb. Entire system has been CAA-approved. The emergency pneumatic system weighs less than 50 lb., or 170 lb., with floats.

Now!...the NEW
ROBINSON WIRE TWISTER
with DIAGONAL GRIP-HEAD



Faster, more efficient than ever! The new, slendernose DIAGONAL GRIP-HEAD is designed especially for those narrow- hard-to-reach places. Split-second whirling action safety-wires 3 engines in time required for one by any other method . . . saves as much as $140 per engine assembled.

3-TOOLS-IN-1 . . . pliers-cutters-twisters. Side-cutting, oil-tempered head. Permanent bronze bearing. No adjustments. Jaws lock on wire, can't slip off. Perfect, uniform twist every time.

12" —for assembly line safety wiring, 15 oz. $21.50
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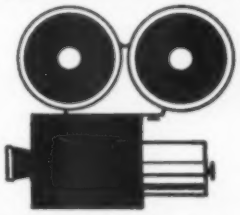
70MM—10A
RECORDING CAMERA



Up to 60 f.p.s. on 70mm film with 400 or 1000 ft. magazine. Intermittent film movement with registration pins below aperature. Furnishes high quality 2.25x2.25 inch picture. Shutter adjustable to 90° maximum opening. Removable 10X boresight tube for critical focusing and viewing.

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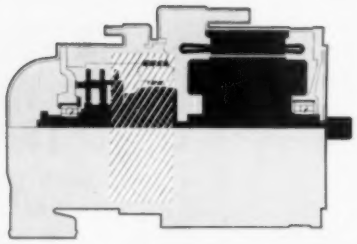
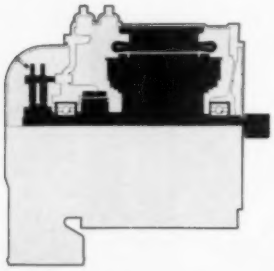
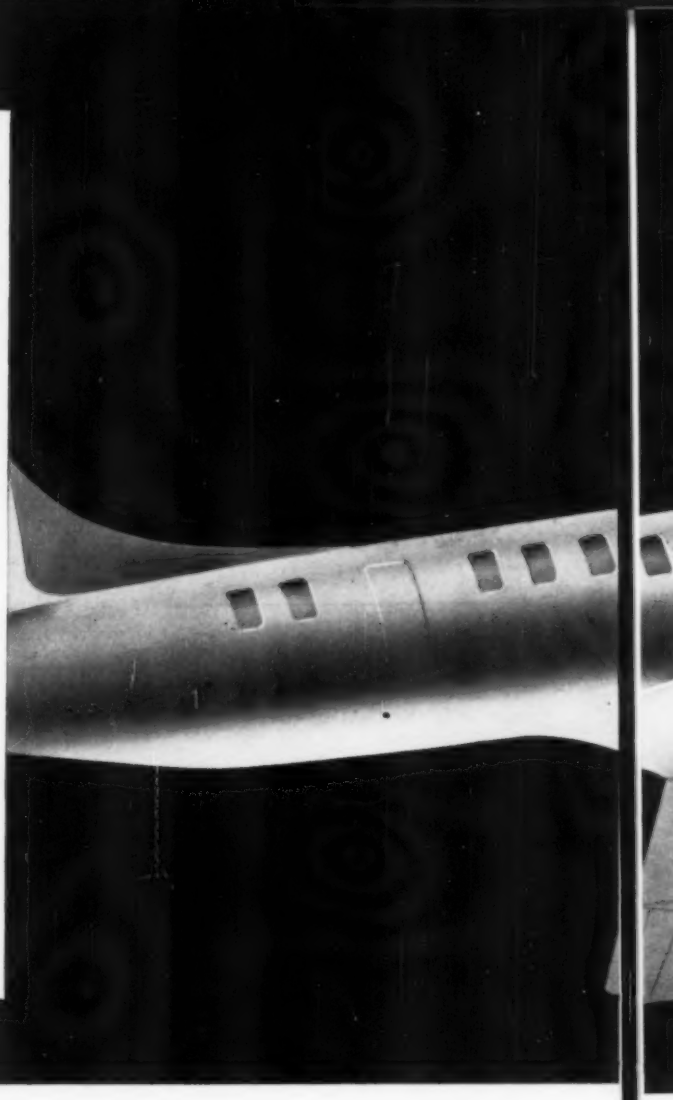


CONVENTIONAL 60 KVA GENERATOR



NEW STATICALLY EXCITED 60 KVA GENERATOR

Static exciter components mounted within the fuselage of the Lockheed Electra replace the rotating exciter of conventional generators. This design simplification reduces generator overhung moment by approximately 180 pound-inches, eases handling, and improves generator cooling and ability to withstand vibration.



Why Lockheed Electra Will Use New General

DESIGN SIMPLIFICATION GIVES RELIABILITY DEMANDED BY TURBINE-POWERED AIRCRAFT

The new Statically Excited Generator combines the proven design principles of the conventional General Electric generator with the increased performance potential of static excitation.

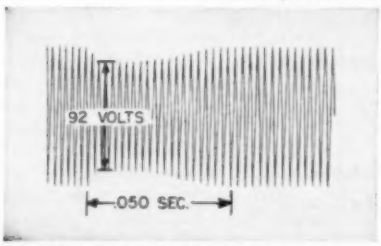
Unscheduled delays due to rotating exciter failure or lack of residual magnetism are eliminated. Maintenance cost is reduced because static exciter parts do not need attention between major aircraft overhauls and commutator undercutting and neutral brush setting at time of overhaul are eliminated. Reduced size of the new generator simplifies removal and installation. Also radio interference problems are greatly reduced by elimination of the commutator.

Fire hazard due to energy available for feeder fault after trip is minimized because the static excitation system retains less than one volt a-c while rotating exciter systems have residual of from 50 to 100 volts. Design improvements in the new generator allow higher operating temperatures, permitting one generator to carry the load of two under emergency conditions.

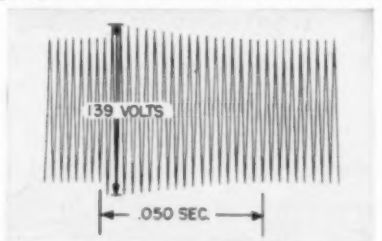
For further information on the new Statically Excited Generator contact your nearest G-E Apparatus Sales representative or write for bulletin GEA-6015, Section 210–100, General Electric Co., Schenectady 5, N. Y.

Electric Statically Excited A-C Generators

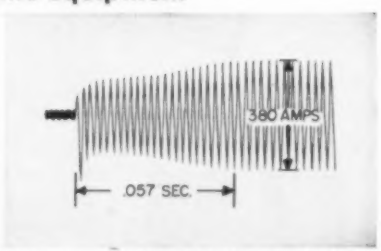
Fast Response Improves Performance of Electronic Equipment



APPLICATION OF FULL LOAD—Normal voltage is reached in .050 second after application of full load. Voltage dip reaches 92 volts—80% of normal voltage.*



REMOVAL OF FULL LOAD—Normal voltage is reached in .050 second after removal of full load. Maximum overshoot is 139 volts—121% of normal voltage.*



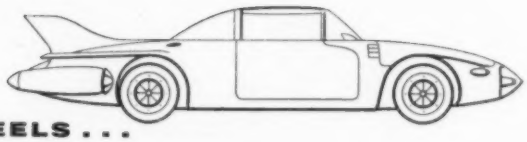
SHORT CIRCUIT BUILD-UP—Achieves full short circuit output in .057 second after three phase fault. Steady state current is 380 amps—342% of rated current.*

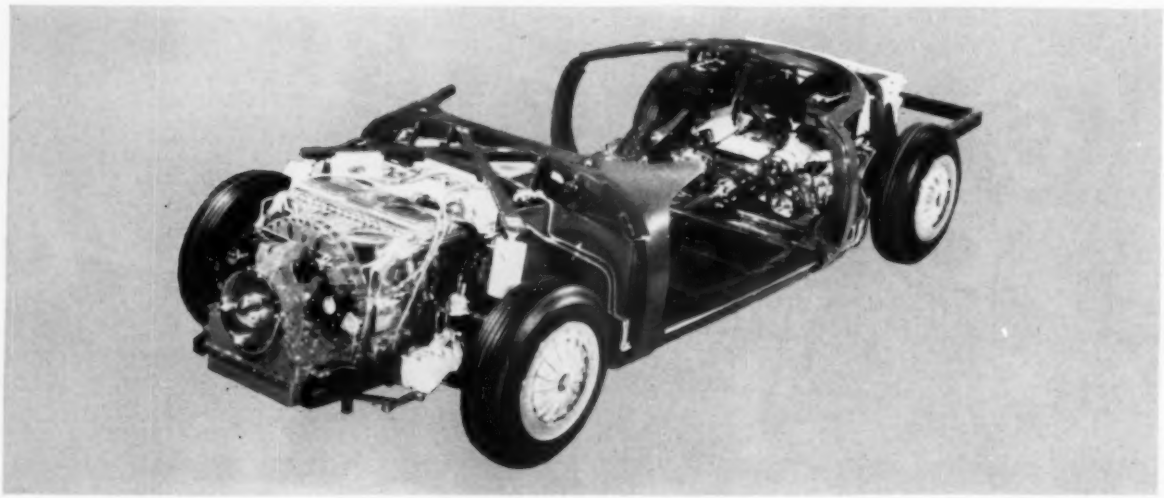
**Performance obtained with a typical 40 KVA model.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

FROM 35000 RPM AT THE TURBINE
TO 2400 RPM AT THE WHEELS . . .





HYATTS SMOOTH THE FLOW OF POWER IN GM'S EXPERIMENTAL FIREBIRD II

Taming the terrific torque of this gas turbine developed by the GM Research staff is no job for ordinary bearings. Only the *finest* straight cylindrical roller bearings can stand the gaff!

HYATTS easily handle the whirlwind speeds generated, and at the same time let the turbine shafts float horizontally when they heat up. This "free lateral" feature automatically compensates for shaft expansion *without changing the bearing centers.* In the reduction gear train, too, HYATTS pass along the power with minimum frictional losses and maximum resistance to the punishing stress and strain.

So if you've got a tough gas turbine bearing problem, come to HYATT for help. Remember . . :

HYATT has more experience with gas turbine applications of roller bearings than anyone else in the field—why not profit by it?

HYATT ROLLER BEARINGS

STRAIGHT ◯ BARREL ◯ TAPER ◯

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

ates the diaphragm to open or close the aperture. Oscillation is approximately 1,800 times a minute, making possible the 1.8-second diaphragm range movement.

The camera also incorporates an advance in rotary shutters. Rotary shutters as such are old hat in movie cameras, but most designs have used a variable angular opening to control exposure. This has called for a complicated differential mechanism to control the variable angular opening, and angular differences in the opening itself have caused exposure variations. Furthermore it is difficult to make the shutter reassume a precise slit width.

Efficiency of this shutter varies with the width of the slit. The narrower the opening the less efficient the shutter. The reason is that the penumbra effect becomes more pronounced, penumbra being the shaded area cast on the film by the edge of the shutter.

Fixed Opening

The Fairchild shutter, by use of a fixed angular opening, maintains a constant shutter efficiency over the entire exposure range. The front element of shutter blade rotates at a constant 64 rps. regardless of film pull-down speed. This gives the shutter its 1/250th of a second speed, which is quite fast, and desirable to cut down blurring from high aircraft speeds.

In a standard shutter there is a straight-line one to one relationship between feet-per-second film pull-down

RB-58 System Simplified

A major improvement in the RB-58 aerial reconnaissance system, now in pilot production at Fairchild, is the incorporation in cameras of all component controls. By this elimination of black boxes on racks, the system is much simpler and has fewer connections, reducing trouble potential.

Besides a weight reduction (AW April 30, p. 23), Fairchild engineers have cut the total system size from 114 cu. ft. to 65 cu. ft. But the 9x9 in. camera film capacity has been increased from 390 ft. to 500 ft.

System includes three 9x9 in. and three 9x18 in. cameras, one 70 mm. forward facing image motion compensation camera, and two alternate co-installations —a single 70 mm. downward aiming camera or a fan of five downward facing 70 mm. cameras.

The television closed loop viewfinder, gyro-stabilized, has an azimuth sweep of 45 deg. right and left, elevation control from straight ahead to 90 deg. down, fields of view of 10 and 40 deg. and a light range of 0.5 to 8,000 ft.-lamberts.

MALLORY·SHARON reports on

TITANIUM

How a **METAL IMPROVEMENT** *helps maintain B-52 production schedules*

• Here's the Boeing B-52 global bomber . . . flying 400 pounds lighter because the new metal titanium is used extensively in the jet engine pods. But in forming titanium parts, Bell Aircraft, one of the firms which produces the complete pod assemblies, originally encountered production delays because of variable "springback" in forming titanium sheets of different strengths.

To overcome this, Bell segregates titanium into different strength groups, which are color coded and handled separately with improved forming techniques. Here Mallory-Sharon's new "quality certification" of titanium proves a substantial time saver. With this method, we not only meet specifications, but certify average strength of each heat we produce, and certify that 97.5% of each heat is in a narrow range of this average. This eliminates the need for tests to segregate incoming material . . . helps cut fabrication costs . . . and permits meeting production schedules on time.

Quality certification is another first from Mallory-Sharon . . . a leading producer of titanium and titanium alloy mill products. Call us for your requirements in this lightweight, strong, corrosion resistant metal.

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MALLORY Ti SHARON

he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers — and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

McGRAW-HILL PUBLICATIONS

speed and shutter rotation. The slower the film speed the slower the shutter revolves, and the angular opening becomes narrower—and thus less efficient—when it compensates for the retarded shutter speed.

The rear element of the Fairchild shutter, the capping blade, has a rotational speed that varies with the frame rate.

At the fastest speed, 64 frames per second, the film is exposed once for every revolution. At 32 frames per second the second shutter caps or blacks out each alternate exposure, and at 16 fps. the second component caps three out of four exposures. Angular opening between the blades remains constant, the exposure variation accomplished by capping.

This eliminates the complicated differential mechanism and hard-to-obtain angular tolerances of standard shutters.

Sprocket Film Drive

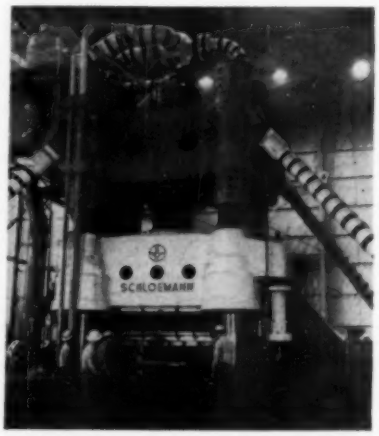
Fairchild engineers developed a continuous input, intermittent output sprocket film drive. Standard "claws" to advance the film were discarded.

With the new drive, several film sprocket holes are always engaged with the sprocket wheel, assuring constant engagement and positive drive film advance.

The continuous input is converted to intermittent output through an unusual adaptation of a Geneva-type of drive.

Film capacity of the KB-5 is 50 ft.

Fairchild officials feel that the KB-5, with its built-in exposure control and other advanced features, will obviate the necessity of building and retrofitting exposure control attachments for existing N-9 gun cameras.



Aluminum Forging Press

Huge 8,000-ton hydraulic press produces high strength aluminum forgings up to 500 sq. in. in area at Alcoa's Vernon, Cal. plant. Four steel struts at the corners make the press earthquake-proof.

Over a million airline hours of turbo-prop Viscount experience will be built into the Viscount 810·840

the new 400 mph turbo-prop

VISCOUNT 810·840

higher cruising speed...
up to 400 miles an hour.

bigger capacity...
up to 70 passengers.

greater economy...
with the new Rolls-Royce Dart R. Da. 7 or R. Da. 8 turbo-prop engines.

world wide experience...
gained from over a million hours of Viscount operations.

passenger preference...
as proved by the sensational traffic records of the Viscount 700.

These advantages make the Viscount 810·840 the ideal aircraft for medium-haul, high density routes. It will surpass even the Viscount 700 series as a money maker for progressive airlines all over the world. The new Vickers Viscount 810·840 will make its debut in service for Continental Airlines in 1958.

Behind the new Viscount 810·840 stands the great name of the Vickers Group—internationally famous as makers of aircraft, ships, industrial machinery and precision equipment.

U. S. Representative: Christopher Clarkson, 10 Rockefeller Plaza, New York 20, N. Y.

***turbo-prop* VICKERS**

VISCOUNT

POWERED BY FOUR ROLLS-ROYCE DART ENGINES

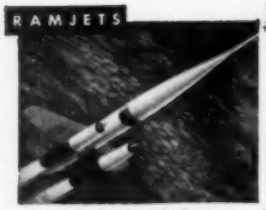
VICKERS-ARMSTRONGS (AIRCRAFT) LTD., WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

OMAR

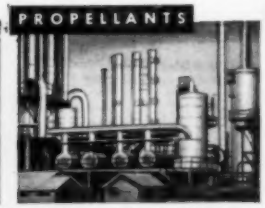
breaking through problems of supersonic propulsion

THE WEAPONS SYSTEMS CONCEPT IN ACTION

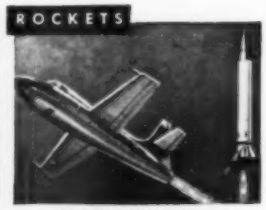
Joining skill and experience in research, development, and production of supersonic powerplants and fuels, Marquardt Aircraft, Olin Mathieson Chemical, and Reaction Motors demonstrate the weapons systems concept in operation. Coordinated through the OMAR Joint Technical Committee, these recognized leaders in the fields of rocket and ramjet engine design, chemical research, metallurgy and fuels are adding new team impetus to the advancement of supersonic aircraft and missile propulsion.



Marquardt Aircraft Company
Van Nuys, California



Olin Mathieson Chemical Corporation
New York, New York



Reaction Motors, Inc.
Denville, New Jersey

MARQUARDT AIRCRAFT
OLIN MATHIESON CHEMICAL
REACTION MOTORS
OMAR

OMAR

Engineers in training... Experienced engineers...

...there's no limit to the opportunities open to you as members of the OMAR team in the fields of:

Rocket and Ramjet Engines
Propellants and Fuels
Testing and Evaluation

Positions are open for the following:

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combustion engineers
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development engineers
process design engineers
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physicists
mathematicians
organo-metallic specialists
inorganic chemists
organic chemists
polymer chemists
electrochemists
physical chemists
analytical chemists

On the OMAR team, you're affiliated with pioneers in the field of supersonic propulsion: **Reaction Motors, Inc.,** first in the American rocket industry; **Marquardt Aircraft Company,** the West's largest jet research and development center and first in ramjets; **Olin Mathieson Chemical Corporation,** a leading producer of chemicals, metals, explosives, and high-energy fuels.

You're on a team that unites for the first time both chemical and mechanical experience in research, development, and production of supersonic rockets, ramjets, and liquid and solid propellants.

For further information write *OMAR Employment Officer* at the company nearest you.

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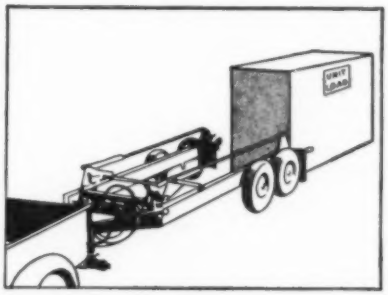
Reaction Motors, Inc.
Denville 1, New Jersey
Marquardt Aircraft Company
16554 Saticoy Street
Van Nuys, California

Cargo Vehicles Suggested to USAF



"Air mobile tactical forces should be equipped with lightweight, independent cargo carriers capable of self-loading and self-discharging to allow high vehicle utilization."

That is one major conclusion in a report recently completed for the USAF by Stanford Research Institute. For the past three years the institute has been conducting logistics and development planning studies under an expanding program for the military services.

The report states that "two types of independent vehicles are proposed for air base use in lieu of the present, conventional carriers: a family of U-shaped, open-top, straddle carrier trailers, and a group of lightweight, rough-terrain fork-lift trucks.

It was estimated that an air base receiving 100 tons of air cargo and bombs per day requires a total of 80 men and about 80 tons of conventional vehicles, two fork-lift trucks, two cranes and seven cargo trucks.

The same job could be done by two independent vehicles weighing 15 tons or less and operated by 12 men, says the Stanford proposal.

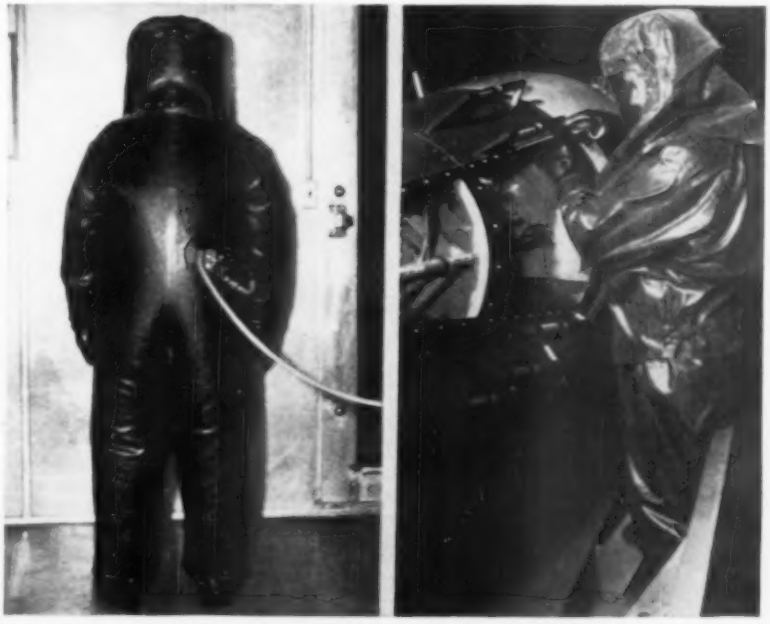
Lockheed Test Pilots Get Earlier Briefings

Los Angeles—Under a reorganization at Lockheed Aircraft Corp., production test pilots will be brought into the picture in new airplane model development earlier than in the past, and will "live with" the airplane through its entire development.

Announcement of the change in production test pilots' role was made by A. W. (Tony) LeVier, Lockheed director of flight operations.

In another move, flight operations has assumed more responsibility for indoctrination of customer flight personnel in Lockheed equipment operation, LeVier said.

Application of the production test pilot role has started on four new models, the F-104A, T2V-1, Model 1649 and Electra.



New Navy Protective Suits

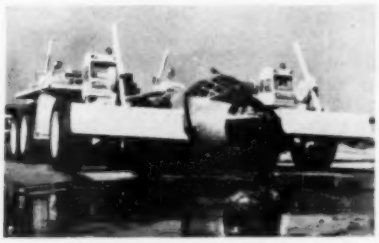
The Navy's Clothing Supply Office at Brooklyn, N. Y., has developed two new types of protective suits for personnel handling hazardous fuels and rocket propellants. Special purpose protective suit (left) has hose attached for supplying air to wearer. Navy man (right) is wearing general purpose suit while working on model of Viking rocket. The suits are made of cotton with a resin modified butyl rubber coating.

NEW AVIATION PRODUCTS

Propeller Control Simulator

A simulator for production or prototype testing of propeller controls duplicates many flight conditions, such as air loading effects of the plane and engine response indications. Non-linear schedules and rates of response to various elements are also included.

Newton Co., Manchester, Conn.



Twin Pushers Remove Wrecks

Vehicles designed to clear runways of crashed aircraft weighing up to 400,000 lb. in less than 20 min. have been developed for the Air Force. Air Research & Development Command says that formerly heavy movers took five to 15 hrs. to do this job. Photo shows two of the new vehicles moving a wrecked Convair B-36.

The $150,000 vehicles each weigh 150,000 lb. and have six 10 ft.-diameter wheels. They operate in pairs and use scoops to remove the wreck.

R. G. LeTourneau, Inc., Longview, Tex.

Cable and Fittings Tester

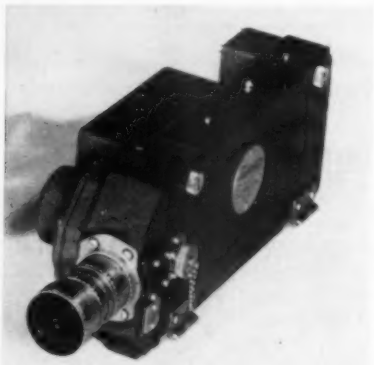
Machine for proof-testing aircraft cable and fitting assemblies is capable of testing cables up to 7,000 lb. pull. It has automatic cycling with tension holding for 10 seconds. The machine meets military requirements for cable tests.

Hewitt & Faust Manufacturing Co., 1071 Industrial Place, El Cajon, Calif.

Highspeed Analysis Camera

A highspeed motion analysis camera that can take good quality 16-mm. photos is being field tested. Airborne model takes a maximum of 2,000 photos per second. A missile "hit-miss" version is being developed to take 1,000 pictures per second.

A rare-element glass in the four-side



prism systems has a high index of refraction and low dispersion, providing color transparencies free from fringing. Units are designed to operate at 55 G shock without causing optical distortion or malfunction.

Fairchild Camera & Instrument Corp., Robbins Lane, Syosset, N. Y.

Shutoff Valves for 2,000 Psi.

Two-way solenoid-operated shutoff valves for 2,000 psi. service have

straight-through port construction permitting compact straight-line runs of hydraulic tubing. Standard sizes are available for one-quarter, three-eighths and one-half-inch tube systems.

A balanced inverse poppet provides a wide range of flows and pressures in either direction. Units exceed MIL-V-5529A specifications.

Aircraft Products Co., 300 Church Rd., Bridgeport, Pa.

Drug Fights Fatigue

U.S. Air Force is testing a new anti-fatigue drug called Meratran that is reported to combine safety and a minimum of undesirable effects with the ability to maintain personnel concentration and efficiency. Meratran, it is reported, appears to avoid effects on

Light Pneumatic Spheres

These 900-cu. in. capacity fiber glass spheres, used for aircraft pneumatic applications, weigh 16 lb., compared with 25 lb. for comparable wire-bound steel containers. This weight saving can be significant in high-speed jets. Manufactured by Walter Kidde & Co., Inc., units come in volumes from 50-5,000 cu./in. with operating pressures to 5,000 psi.

VOUGHT...FOR COMBAT SUPERIORITY

Engineered by Vought ...World's

Fastest Navy Fighter

Faster-than-sound *Crusader* Will Strengthen U. S. Fleet's Command of the Skies Above the Seas

Chance Vought's F8U-1 *Crusader* represents the next generation of Navy fighters. It combines supersonic level flight performance with exceptional combat ceiling, long endurance and ease of maintenance.

Agile and amazingly lethal, the *Crusader* meets the demands of shipboard operating requirements with no sacrifice in speed and striking power. It will give air superiority to the U. S. Navy wherever its task forces operate.

Behind this triumph in aviation achievement lay an intensive research and development program...and experience gained in 38 years of pioneering leadership. Like many other significant Vought advances, it emphasizes a tradition of engineering excellence.

In the field of high performance aircraft, as well as guided missiles, the creative spirit is strong at Vought. Because of this spirit, America can continue to expect superior new weapons from Chance Vought—as long as the need for them exists.

SCIENTISTS AND ENGINEERS: There is a challenging place for you on Vought's creative team now. For details write: Engineering Personnel, P. O. Box 5907, Dallas, Texas.

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

DESIGNER AND BUILDER OF HIGH PERFORMANCE MILITARY AIRCRAFT SINCE 1917

For HEATING, VENTILATING and AIR CONDITIONING

NEW...

WESTINGHOUSE AIR HANDLING COMBINATION UNITS in 13 basic sizes give you Unlimited Selection...

The most complete line for every job—Westinghouse Air Handling Combination Units handle from 500 to 48,500 CFM.

These versatile units, each with a choice of two coil face areas; in five coil types (see panel at right) and accessories as required, permit you to select from the broadest line in the industry.

Only Westinghouse Gives You:

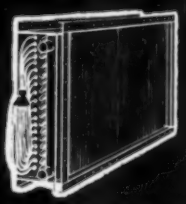
- High Efficiency
- Quiet Operation
- Non-Pulsating Air Flow
- Corrosion-Resistant Construction
- High Capacity—Low Resistance Coils
- Single Equipment Warranty

For complete application service, call your Consulting Engineer or your nearest Sturtevant Division Sales Engineer . . . or write Westinghouse Electric Corporation, Sturtevant Division, Department 3E, Hyde Park, Boston 36, Mass.

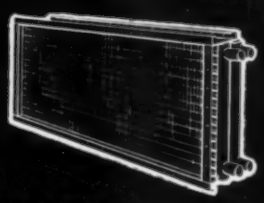
WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

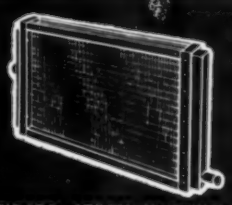
J-80591



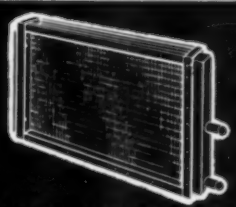
DIRECT EXPANSION FOR COOLING AND DEHUMIDIFYING . . . 3-4-5 and 6 rows deep.



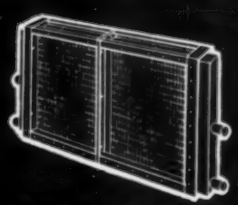
WATER COILS . . . for heating, cooling and dehumidifying—2 through 8 rows deep.



STANDARD STEAM HEATING COILS . . . for use with modulating damper control—1 and 2 rows deep with 3 fin spacings.



STEAM DISTRIBUTING TUBE COILS . . . for use with modulating steam valve control—1 and 2 rows deep with 3 fin spacings.



DUAL FEED STEAM DISTRIBUTING TUBE COILS . . . available in fin tube lengths—78 through 120 in.—1 and 2 rows deep with 3 fin spacings. Operates as two coils in single casing—supply and condensate connections at each end—eliminates stratification.

blood pressure and slumps in reaction experienced with other drugs of this type.

Tests were conducted by USAF School of Medicine, Randolph AFB, Tex.

William S. Merrell Co., Cincinnati, Ohio.

Aircraft Crash Recorder

An instrument for recording an aircraft's history of acceleration, airspeed, altitude, fire locations and structural failures for the time preceding the accident, retains information only if the plane crashes. Of the constant record-and-erase magnetic type, it does not use electronics in either the recorder or for playback.

Record is a metal plate; reloading is not required.

Gateway Manufacturing & Development Corp., P.O. Box 539, Los Altos, Calif.

Plastic Coated Fabric

A Dacron fabric coated with Hypalon plastic, developed by Air Research & Development Command for air-supported radar structures, will provide weight savings of about 50% over existing fabrics.

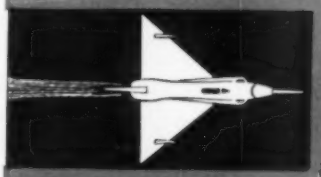
Called Dacralon, the material is reported to have excellent electrical properties; good resistance to sunlight and ozone aging. Material weighs about 7.5 oz./sq. yd.; exterior has a coating of about three to 3.5 oz./sq. yd. and the interior about 1 to 1.5 oz. Breaking strength is estimated at 450 lb./sq. in.

Air Research & Development Command, U. S. Air Force, P. O. Box 1395, Baltimore 3, Md.

WHAT'S NEW

Telling the Market

Application methods, etc. on Jennite J-16, **surface seal for asphalt pavements,** catalog LL-2992, Maintenance, Inc., Wooster, O. . . . How to pack for **maximum instrument protection,** brochure, Armour Curled Hair Division, North Benton Rd., Alliance, O. . . . **Carbon**



added Performance

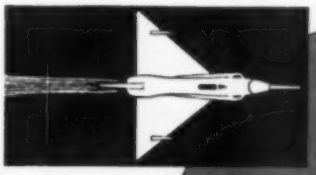
teflon® CABLE

More approved Teflon coaxial cable types are available from AMPHENOL *than from any other source!*

Military Number RG-/U	AMPHENOL Number	Nom. Imp. Ohms	Max. Oper. Volts R.M.S.
62C	421-100	98	750
87A	421-250	50	4000
115	421-641	50	4000
115A	421-699	50	4000
116	421-378	50	4000
117	421-377	50	5000
118	421-374	50	5000
119	421-398	50	5000
120	421-399	50	5000
126	421-443	50	2000
140	421-379	73	1700
141	421-382	50	1500
142	421-385	50	1500
143	421-388	50	2000
144	421-391	72	3000

Teflon cables operate without difficulty at temperatures from −55°C to +200°C. The high power-handling capabilities and the weight and space saving possible with Teflon cables make them ideal for avionic equipment.

AMPHENOL



added Reliability

CAPTIVATED CONTACT* RF CONNECTORS

Only AMPHENOL provides connectors to go with the Teflon cable it makes—not only a single-source advantage but also a guarantee of engineering responsibility. Latest addition to this RF connector line are Captivated Contact connectors in Series N and HN. These assemble with 87A, 115 and 115A Teflon cables, provide *added* reliability.

**patent pending*

AMPHENOL

AMPHENOL ELECTRONICS CORPORATION
chicago 50, illinois
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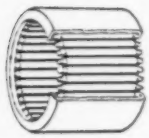
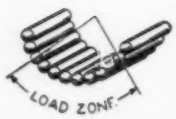
TORRINGTON

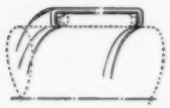
DC needle bearings give high-capacity performance in minimum space



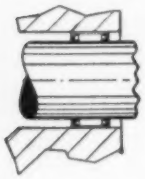
Unique construction—accurately drawn, surface-hardened shell retains rollers and serves as outer raceway.



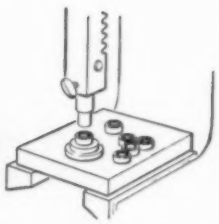
Full complement of small diameter rollers—precision-ground and through-hardened—assures top capacity by distributing load over large number of contacts.



Turned-in lips of the case-hardened outer shell keep dirt and grit out, lubricants in—while retaining trunnion ends of rollers. All wear surfaces of outer race are case-hardened.



No inner race required on surface-hardened shafts—reduces space requirements, lowers unit costs.



Simple assembly—arbor press seats bearing in round housing bore. No collars, shoulders or retaining rings needed.

Closed end type DC Needle Bearings are available for stub shaft applications. The closed end provides a perfect seal at no extra cost.

Needle Bearings are made in a Precision Series for most applications and an Extra Precision Series where low radial play and minimum eccentricity are required. Easy lubrication through optional hole in shell or through hole in shaft assures long service life. Bearings can be pre-packed with suitable grease for those applications requiring grease lubrication.

See our new Needle Bearing Catalog in the 1956 Sweet's Product Design File—or write direct for Catalog No. 55.

THE TORRINGTON COMPANY
Torrington, Conn. **South Bend 21, Ind.**

District offices and distributors in principal cities of United States and Canada

TORRINGTON BEARINGS

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

brushes for industrial, military and commercial applications, Catalog 56, Pure Carbon Co., Inc., St. Marys, Pa. . . . Selection tables, performance charts, etc., on airborne **oil-hydraulic components** and complete systems, Bulletin A-5200-D, Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.

Presentation of **small precision instrument ball bearings,** technical manual, New Hampshire Ball Bearings, Inc., Peterborough, N. H. . . . Parts brochure of **feed through and standoff terminals** and custom-molded nylon and plastic components, Whitso, Inc., Dept. AWN, 9330 Byron St., Schiller Park, Ill. . . . Broadside CP-8326 on uses, specifications and prices of **dispensers for gummed and pressure sensitive tape,** and Salesmaker #13 on **two-strip reinforced tape method** of carton sealing versus six-strip, Better Packages, Inc., Shelton, Conn. . . . Sizes, hose capacities and reel variations of **hose reels** for fuel delivery equipment, catalog, Clifford B. Hannay & Son, Inc., 24 Maple St., Westerlo, N. Y.

Extrusions by Harper, booklet, H. M. Harper Co., Metals Division, 8200 Lehigh Ave., Morton Grove, Ill. . . . Chart of **physical properties of tooling resins,** including casting and laminating materials and brochure on Epibond epoxy adhesives, Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif. . . . Guide to **manometer-type instruments,** bulletin, Meriam Instrument Co., 11054 Madison Ave., Cleveland 2, O.

Application techniques and precautions, advantages and limits of **adhesive binding** at room temperatures, booklet, Rubber & Asbestos Corp., Dept. P., Bloomfield, N. J. . . . **Unplasticized polyvinyl chloride pipe,** bulletin, Alloy Tube Division, Carpenter Steel Co., Union, N. J.

New Publications

The Aircraft of the World—by William Green and Gerald Pollinger—Pub. by Hanover House, 575 Madison Ave., New York 22, N. Y. $7.95. 211 pp. About 1,200 ill.

Specifications, photo, three-views and details of nearly 1,000 aircraft, including rotary-wing. Covered are not only new aircraft, but many old-timers still active.

The Airplane at Work for Business and Industry—Prepared by the Office of Planning, Research and Development and available through the Civil Aeronautics Administration, U.S. Department of Commerce, Washington 25, D. C. $1.00. 75 pp.

This review presents the results of a 1955 survey covering all civil flying in 1954 except that performed by the scheduled airlines and by the CAA itself.

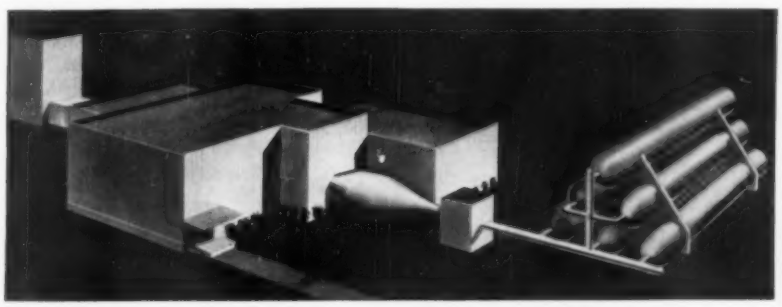
Preliminary estimates for 1955 are included in the survey.

Aviation Directory of Canada—Pub. by Aircraft Magazine, 341 Church Street, Toronto 2, Ont., Canada. U.S. price $5.00.

Sections on the aircraft industry; the air transport industry; military aviation: government departments and organizations; aviation organizations and publications; sources of supply and services.

A Simple Guide to Blueprint Reading with Applications to Aircraft—by William N. Wright—Pub. by McGraw-Hill Book Co., 330 West 42 Street, New York 36, N. Y. (A revised edition of **A Simple Guide to Blueprint Reading,** Copyright 1941, 1945, by William N. Wright.) Photographs and many diagrams.

A guide to blueprint reading.



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(Continued from page 23)

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Richard W. (Dick) Taylor, flight test chief, Wichita, succeeding **A. Elliott Merrill** assigned to Seattle Transport Division military sales, Boeing Airplane Co., Seattle, Wash.

Vernon H. Vogel, engineering director, Aeronautical Division, Robertshaw-Fulton Controls Co., Anaheim, Calif.

Samuel L. Higginbottom, engineering manager, Kansas City overhaul base, Trans World Airlines.

K. H. Knox, engineering sales manager, Weston Hydraulics, Ltd., subsidiary Borg-Warner Corp., North Hollywood, Calif.

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David N. Harrison, engineering service representative, Adel Precision Products, eastern office, Mineola, N. Y.

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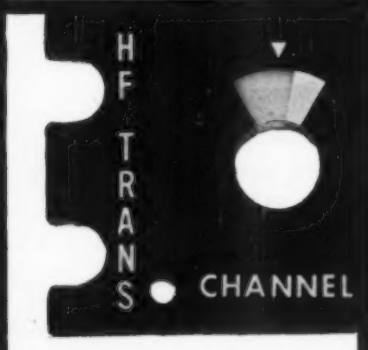

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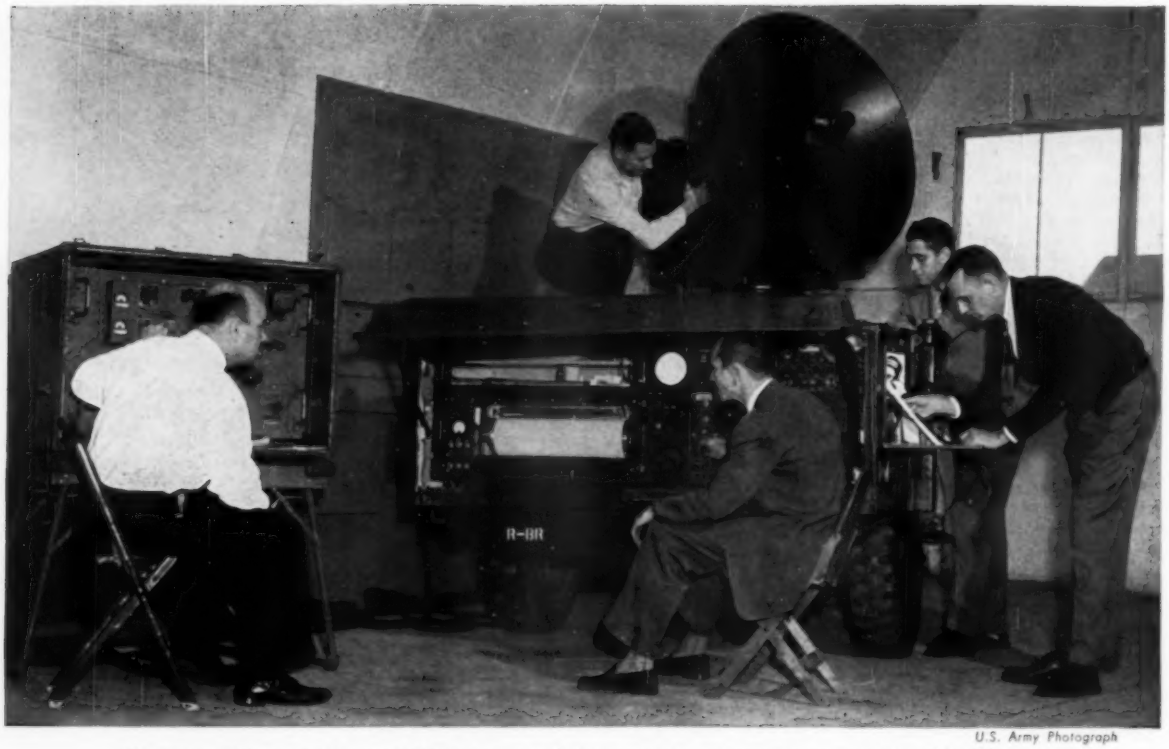

U.S. Army Photograph

Electronic specialists at Ft. Monmouth SCEL Laboratories checking out radar and computing system designed for field use.

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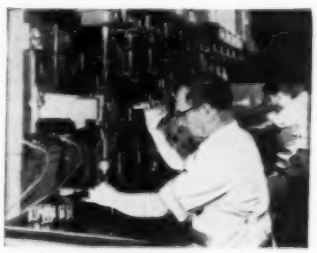

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British Accidents Investigation Branch Report:

Wrong Prop Feathered, Viscount Fell

A Vickers-Armstrongs Viscount Type 701, owned and operated by the British European Airways Corp., crashed during takeoff on a training flight at Blackbushe Airport, England, on Jan. 20, 1956, slightly injuring all five persons on board.

Capt. D. A. Longhurst was in command of the training flight. Others in the plane were Capt. D. J. Turner, Radio Officer J. A. Miller, Capt. P. G. Sooby and First Officer R. A. Treadaway.

The accident took place at 0850 hours, Greenwich Mean Time (all times in this report are GMT).

The accident occurred during takeoff on a training flight which was part of a routine Base Check being carried out by Captain Longhurst, a Training Captain, on Captain Turner, a Line Captain. Upon reaching the takeoff safety speed Captain Longhurst simulated a starboard outer engine failure.

At this point the aircraft was just leaving the ground, and as it did so the starboard inner propeller was seen to be stopping and the aircraft began turning to the right with an increasing amount of bank. It rose to about 30 feet and then descended and hit the ground at a point some 250 yards from the runway in a steeply banked, nose-down attitude. It cartwheeled and slid along the ground backwards for 200 yards, coming to rest just inside the north-west boundary of the aerodrome. The aircraft sustained major impact damage and fire broke out which almost completely destroyed it. The five occupants escaped with only slight injuries.

NOTIFICATION

By telephone from Blackbushe Air Traffic Control at 0910 hrs. on 20th January, 1956. The scene of the accident was visited the same morning.

FURTHER DETAILS

The aircraft was constructed by Vickers-Armstrongs Ltd. at Weybridge in 1953 and was registered in the name of British European Airways Corporation on 12.12.53. The Certificate of Airworthiness was renewed on 8.2.55 and was valid. There were valid Certificates of Maintenance, and the aircraft and its engines had been maintained in accordance with an approved Maintenance Schedule. Loading and the centre of gravity position were both within the permissible limits. The aircraft had flown for a total of 3,796 hours.

The Crew

• **Captain Longhurst**, aged 36, held a valid Air Line Transport Pilot's Licence with an Instrument Rating and an endorsement in Group 1 for Viscount 701. He also held a General Flight Radiotelephony Operators Licence. He is approved by the Minister of Transport and Civil Aviation as an instrument rating examiner.

After serving with the R.A.F. during the war he joined B.E.A. in July, 1946 and was made a Captain the following December. He was selected as a Training Captain in November 1951 since when he had been continuously engaged in training duties. He was promoted to Senior Captain in December 1951 and when selected for the Viscount Flight in 1952 he was assessed as "a first-class Line Captain and Line Training Captain."

Late in 1954 he was seconded to Trans Australian Airlines for two months to assist in converting their pilots to Viscounts. His last Flying Report was dated 30th December, 1955 when he completed a Line Check "to a high standard throughout" and a Base Check "to an above average standard." At the time of the accident he had completed a total of over 8,100 hours flying, of which about 1,600 hours had been as Captain in Viscounts. He had flown 1,100 hours on training work in Viscounts with a further 800 hours in Vikings.

• **Captain Turner**, aged 36, held a valid Air Line Transport Pilot's Licence with an Instrument Rating and an endorsement in Group 1 for Viscount 701, and a General Flight Radiotelephony Operator's Licence. He was a Senior Captain who had flown 520 hours in Viscount aircraft.

• **Radio Officer Miller** has been a civil air line radio operator since 1945 and held a valid First Class Flight Radiotelegraphy Operator's Licence.

• **Captain Sooby and First Officer Treadaway** both held valid Air Line Transport Pilots' Licences, Instrument Ratings and Flight Radiotelephony Operator's Licences.

Note: At the time of the accident the three last-named were sitting in aft-facing seats in the front row of the passenger cabin with their seat belts fastened. The two pilots were using lap straps.

Meteorological Data

The following observations were recorded by the Meteorological Office, Blackbushe, at 0851 hrs on 20th January, 1956:

• Surface wind—240°(T) 18 kts
• Visibility—25 nm
• Present Weather—Nil
• Cloud—$\frac{2}{8}$ths at 1,200 ft (Estimated); $\frac{7}{8}$ths at 1,600 ft (Estimated).

The Flight

The aircraft took off from London Airport at 0755 hrs. with Captain Longhurst in the right-hand pilot's seat and Captain Turner at the controls in the other seat. A simulated instrument takeoff was made during which Captain Longhurst manually feathered No. 1 propeller on reaching the takeoff safety speed (V_2 speed). Captain Turner carried out the necessary corrective action and the emergency and feathering drills. The aircraft climbed away and proceeded to Cranfield where it arrived at about 0815 hrs.

The intention of making an ILS approach there was thwarted because the frequency had recently been changed and the necessary radio crystal was not on board. Captain Longhurst therefore decided to proceed to Blackbushe. He was given a V.F.R. clearance and then restarted No. 1 engine. On arrival over Blackbushe he again feathered No. 1 propeller preparatory to a three-engined approach and overshoot, using the ILS on Runway 08.

This exercise was completed and was followed by a circuit and three-engined landing on Runway 26.

Manual Feathering

No. 1 engine was again restarted and the aircraft lined up on Runway 26. Captain Longhurst then told Captain Turner that he intended to simulate an engine failure during the take-off sequence which was to be purely visual. Accordingly, upon reaching the V_2 speed of 106 knots when the aircraft was just becoming airborne, Captain Longhurst stated that he carried out manual feathering of No. 4 propeller by the three movements laid down on the B.E.A. drill card, namely by: moving the high pressure cock lever to the feather position, pulling back the throttle lever, pressing the feathering button.

He further stated that he then checked the gauges showing the r.p.m. and torquemeter pressure for No. 4 engine and that both showed zero, signifying to him that feathering was completed. Immediately after this it became apparent to him that Captain Turner was experiencing difficulty in maintaining directional control, as the aircraft was turning to starboard despite application of rudder and aileron controls. Because the rate of turn was increasing and the right wing was dropping Captain Longhurst took over control. As he did so Captain Turner selected the undercarriage up. He then noticed that the aircraft was not accelerating beyond 106 knots and believing that he could still gain control he put the nose down slightly in an endeavour to increase the speed, but as a height of about only 30 feet had been reached the aircraft hit the ground.

Evidence was obtained from three eye-witnesses that No. 3 propeller stopped rotating. One of these was Captain Sooby who was looking out of the front starboard window at the propellers as he expected No. 4 propeller would be feathered during the take-off. Not only did he see No. 3 propeller feather but he also noticed a sudden cessation of noise from the starboard side of the aircraft.

Examination of the Wreckage

Inspection at the scene of the accident showed that initial impact with the ground

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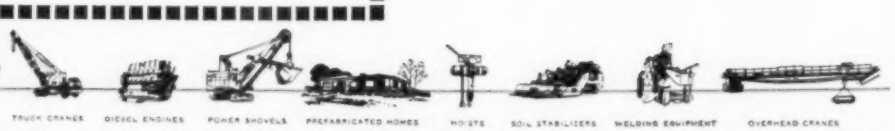

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was made by No. 3 propeller and the nosewheel tyres followed by the starboard underside of the nose and the starboard wing tip. The outer half of the starboard mainplane broke off almost at once, closely followed by No. 3 propeller.

The aircraft cartwheeled, slid along backwards on its belly and came to rest some 200 yards from the point of initial impact. No. 4 engine with its propeller attached broke off at the wing leading edge and was lying clear of the main wreckage. Fire had destroyed most of the aircraft but the nose section was intact and undamaged by fire.

Three of the blades of No. 3 propeller were in the feathering range, whilst three of the No. 4 propeller were in the fine pitch range. Damage to the blades indicated that No. 3 propeller was almost stationary on impact and that No. 4 was rotating.

Examination of the control cabin revealed that No. 3 H.P. cock lever was selected to the feathering position, to attain which the latch must be raised and the lever moved right back through the gate.

The other three H.P. cock levers were forward of the gate. The throttles were all nearly fully open but these positions were considered to be unreliable owing to the effects of crash damage.

Subsequent Examination

Nos. 3 and 4 engines and propellers were removed to London Airport for further examination. It was established that No. 3 propeller actuating piston was in the position to be expected if the H.P. cock lever had been moved to the feathering position and the feathering button had not been operated.

It was also established that the No. 4 propeller piston was so positioned that the blades would have been in fine pitch and giving approximately 10,000 r.p.m. at the moment of impact. Electrical and mechanical feathering and unfeathering operations were carried out on No. 4 propeller in exactly the condition it was in when recovered and it was found that the system functioned normally.

OBSERVATIONS

• **A consideration** of the evidence in conjunction with the B.E.A. drill for manual feathering makes it apparent that Captain Longhurst had moved No. 3 H.P. cock lever (which was two inches longer than No. 4) to the feathering position instead of No. 4, and had then throttled back No. 4 engine and pressed No. 4 feathering button. These actions cut off the fuel from No. 3 engine and feathered its propeller and also reduced No. 4 engine to idling conditions. Pressing No. 4 feathering button had no effect on No. 4 propeller however as the H.P. cock lever was not in the feathering position. The aircraft was thus deprived of all power on its starboard side at the moment of becoming airborne and the situation was made worse by No. 4 propeller idling in fine pitch.

• **Captain Longhurst** believed he had completed feathering of No. 4 engine and to confirm this glanced rapidly at the guages showing r.p.m. and torquemeter pressure for No. 4 engine, both of which he read as zero. Because the engine was throttled right back the torquemeter pressure would have been zero but the small pointer of the two-pointer r.p.m. gauge would have been

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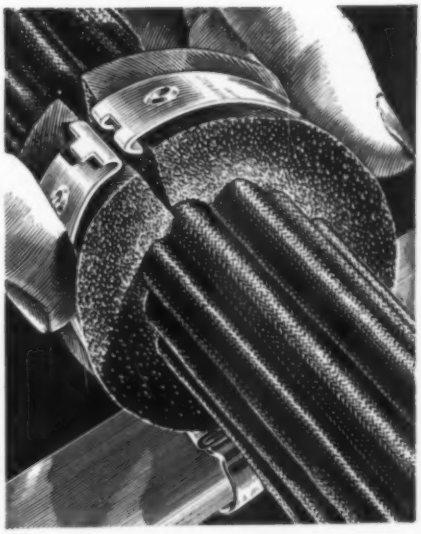

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indicating 10,000. In his rapid glance at this gauge he must have misread it.

• **Movement of the throttle** in the feathering drill on this occasion was not necessary as water-methanol injection was not being used. The movement was included in the feathering drill only to cut off water-methanol injection when that system was being used. Following this accident, B.E.A. issued instructions that simulated engine failures on take-off during training flights would only be made when the use of water-methanol was unnecessary. The drill was altered accordingly to exclude movement of the throttle.

CONCLUSIONS

- The documentation of the aircraft was in order.
- The crew was properly licensed.
- There was no evidence of any pre-crash defect.
- The Training Captain operated No. 3 H.P. cock lever instead of No. 4.
- All power from both starboard engines was lost at a critical point of the take-off.

OPINION

The accident was due to an error by the Training Captain who operated No. 3 high pressure cock lever instead of No. 4 when simulating a failure of No. 4 engine during take-off. This resulted in the loss of all power from both starboard engines at a critical point of the take-off.

COMPLIANCE WITH REGULATIONS

In conducting this investigation the provisions of paragraph (5) of Regulation 7 of the Civil Aviation (Investigation of Accidents) Regulations, 1951—Statutory Instrument No. 1653 of 1951—have been complied with.

(Signed) P. G. Tweedie
Chief Inspector of Accidents

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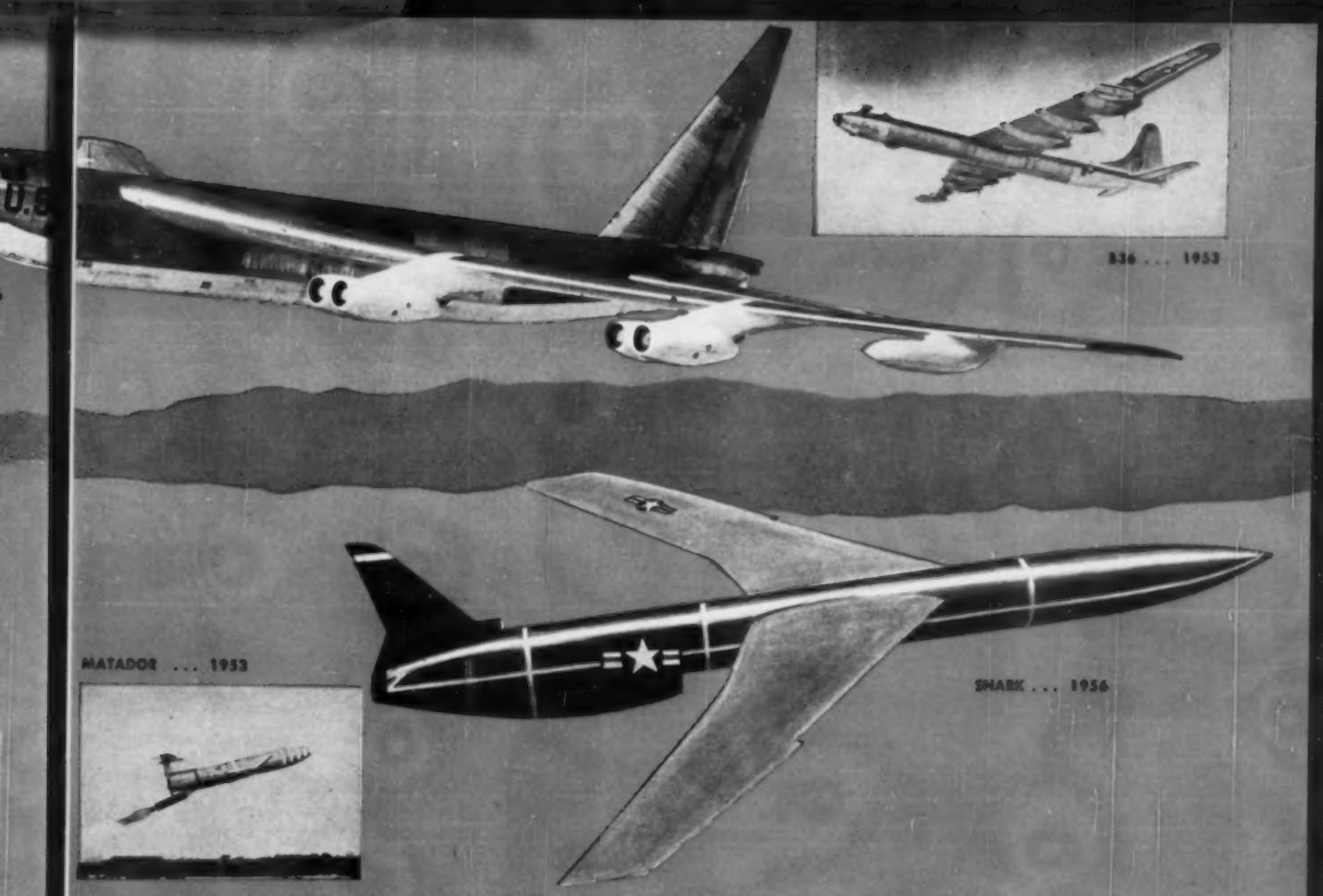

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W. R. Rhoads to Head Dawsonville Project, To Be Biggest of Its Type in Nation

Lockheed Aircraft Corp., wasting no time in the development of nuclear aircraft testing facilities at Dawsonville, announced Tuesday that W. R. Rhoads will head up the Dawsonville project.

Mr. Rhoads, who lives at 120 Osner Dr., NE, is chief staff engineer at Lockheed's Marietta plant now. He has been with Lockheed since 1941.

He will direct the work of the approximately 500 scientists, engineers and service personnel who will be employed at the Dawsonville site.

LOCKHEED AND the Air Force officially announced Monday night at a dinner at Gainesville that they intend to build a 10,000-acre, multi-million-dollar nuclear aircraft test site just southwest of Dawsonville (population, 350).

And, perhaps as significantly, Lockheed's top Georgia executive hinted that the actual manufacture of a nuclear-powered plane—perhaps the world's first—might take place at Lockheed's Marietta plant.

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A MESSAGE TO AMERICAN INDUSTRY • FIRST OF A SPECIAL SERIES

THE SHORTAGE OF SCIENTISTS AND ENGINEERS: *How Critical Is It?*

The United States is running into a serious shortage of scientists and engineers. There is no novelty in this observation. It has often been made in the last few years. And there has been mounting alarm about what this shortage may mean for both our national security and our prosperity.

There would be great novelty, however, if general agreement were attained on such important matters as the size of the shortage, the extent of the damage it threatens to inflict, and the best ways to eliminate it. The purpose of these editorials is not to provide this novelty, but to ventilate some of the key aspects of the shortage of scientists and engineers.

This first editorial in the series is designed to throw light on the over-all dimensions of the shortage. Others will be addressed to such questions as:

- How serious is the threat to our economic well-being and to our national security?
- What needs to be done to prevent the shortage from becoming critical?

Rise in Technical Manpower Has Been Rapid

The problem is *not* that we have been producing a small number of engineers and scientists. Indeed, the number has risen sharply. We now have a working force of more than 600,000 engineers, over twice as many as the 286,000 there were in 1940. And we have about 250,000 scientists (chemists, physicists, biologists, geologists, mathematicians, etc.), compared to only 92,000 in 1940. About one in 148 persons in the labor force of 1940 was a scientist or engineer; today the ratio is about one in every 80.

In research and development work, where highly creative scientific minds are required, there has been fully as rapid a rise in employment of scientists and engineers. Fewer than 90,000 were employed in research and development fifteen years ago; the total now exceeds 200,000.

. . . But Not Rapid Enough

Despite this rapid increase in the number of scientists and engineers—at a rate much faster than the increase in the labor force as a whole—the needs of industry, government and education for technically trained people have risen even more sharply.

The principal reason for this mounting demand is the prodigious growth of research in the last 15 years. From a total of only about $900 million spent on all types of research in 1941, the annual expenditure rose to over $5 billion by 1953 (the latest estimate available). Over two-thirds of the research is done by private industry, mostly to develop new and better products and to find new and better methods of production. Most of the rest is performed by the government, largely to develop improved and inevitably more complex scientific weapons.

One aircraft company has found from its own experience that it required 17,000 engineering manhours to develop a typical fighter plane in 1940. The requirement is now about 1.4 million engineering manhours. Development of the typical fighter plane of 1960 will require well over 2 million engineering manhours.

In this dramatic example, the need for engineering services for a basic piece of military equipment soared 80 times in 15 years. It is an indication

of why the demand for more and more technically trained men and women has outstripped even the imposing increase in scientific and engineering manpower of the last decade and a half.

Size of the Shortage

Exactly how great the gap is between the available supply of scientists and engineers and the number required, it is impossible to say. In some instances technical talent undoubtedly could be better used than it is now. And part of the shortage might "disappear" if higher salaries had to be paid. (These questions will be discussed in later editorials.) But informed estimates of the approximate size of the gap can be given.

● According to the best available information, from estimates by the Engineers' Joint Council and the U. S. Bureau of Labor Statistics, **the minimum need for engineers from graduating classes is 40,000 each year for the next ten years.** Last year we graduated only 23,000 engineers, just about enough to cover replacement needs without allowing for any expansion of the number of active engineers. Projections made by the U. S. Office of Education indicate that we shall probably not have a class of 40,000 – the *current* annual requirement – until 1963.

● According to Dr. Howard Meyerhoff, executive director of the Scientific Manpower Commission, **there is now a shortage of about 20,000 scientists.** Last year the number of doctoral degrees in the natural sciences, almost a prerequisite for research work, was only 5,000. Dr. Meyerhoff estimates that the shortage of scientists will rise another 30,000 by 1960.

More Needed as Teachers

Not all of the graduates with scientific and engineering training, furthermore, will work as scientists and engineers – that is, by performing research and giving it practical application. Such training is now necessary in many sales and management positions. And more of our technically trained men and women must remain in educational institutions as teachers if the quality of engineering and scientific education is to be maintained. A survey in 1954-55 by the National Education Association showed that, out of 277 universities, state colleges and large private colleges, nearly one-third *already* had unfilled vacancies in engineering and three-fourths had vacancies in physical sciences.

The dimensions of the shortage of scientists and engineers can be summarized as follows: **Despite a substantial rise in the trained manpower available, the needs of industry, the government and education have risen still faster. The best information indicates that, on the basis of current and anticipated needs, our recent yearly rates of production of slightly over 20,000 engineers and about 5,000 PhD's in natural sciences could be doubled without closing the gap entirely.**

The disturbing implications of this shortage for our national security and our prosperity and some practical suggestions for eliminating it will be the subjects of subsequent editorials in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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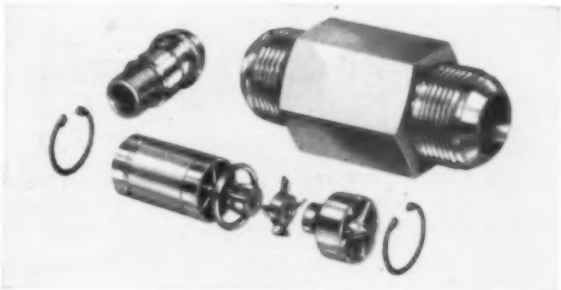

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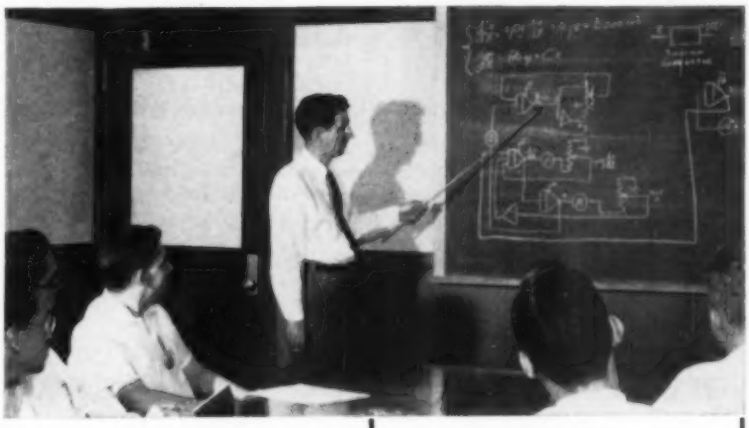

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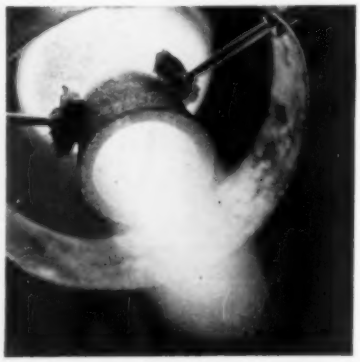

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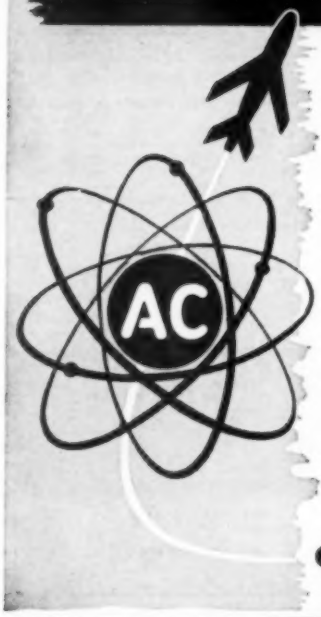

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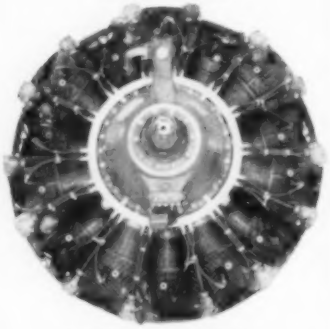

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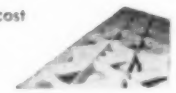

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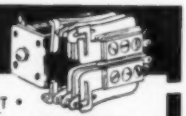

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HARRIS

LETTERS

B-52 Vs. Snark

The past several issues of AVIATION WEEK have given me the impression that the USAF is somewhat undecided about our intercontinental weapons. The problem seems to be whether or not the U. S. should match the Russian's Bison production with B-52's or divert some funds for Snark SM-62 production.

I think the USAF should order more B-52 bombers and no production model Snarks for the following reasons:

(1) The performance of the Snark and the B-52 is about the same.

(2) Both the B-52 and the SM-62 can deliver atom bombs.

(3) The B-52 is more versatile. In a period of atomic deadlock, the B-52 can drop conventional bombs in the event the enemy started another Korean-type war. Also it is possible to convert the B-52's into aerial tankers to refuel future supersonic intercontinental bombers. These are things the USAF can not do with the SM-62.

The argument by Snark enthusiasts that a Snark costs only 5% of a long-range bomber is a poor selling point. SAC has estimated that bomber losses today would be no greater than they were in World War II, i.e., about 5 to 10%. This fact eliminates any financial savings for Snarks because they are one-trip missiles.

The Snark is primarily a prestige weapon. It may be impressive to advertise that the USAF has the first intercontinental missile, but there is more security and versatility in the B-52's.

LEROY F. IVERSON
3524 Elm Avenue
Manhattan Beach, California

ICBM Tactics

On reading your article on defense against the ICBM (AW Apr. 9, p. 44), the thought occurred to me that maybe we were expecting the enemy to be a little too cooperative. What is to prevent him, when he realizes that our defense is based upon a radar, the range of which is limited to 300 miles, from covering the warhead with radar absorbent material? Such materials have attenuations on the order of 20 to 30 db. for thicknesses of two to three inches over the signal obtained from a metal reflecting surface. Using the lower figure of 20 db., this means that the maximum detecting range is reduced by the fourth root of 100 or slightly over three. The maximum detection range is then only 100 miles—hardly sufficient to allow interception outside of 50 miles from the target.

Such a solution is possible on the ICBM where it is impossible on aircraft because the material can be shrouded while in the atmosphere after launching and the shroud can be discarded in outer space.

NAME WITHHELD

(All known materials capable of absorbing, at least partially, radar energy, are either soft rubbery materials or plastics, neither of which are capable of withstanding the ram-air effect or high temperatures encountered in modern military aircraft. It is doubtful that such material could withstand the multi-Mach speeds of an ICBM, where we are currently having difficulty getting metals capable of taking these temperatures. Then too, all known radar-absorbent materials are effective for only a very narrow range or band of radar frequencies. At other frequencies they reflect energy. Since modern radars must be designed to quickly change frequencies to avoid electronics countermeasures tactics, this same capability makes it difficult to find a radar-absorbent material effective over a wide range of frequencies.—Ed.)

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Engineer Shortage

May I congratulate you on the excellent article on "Utilization of Engineers" in your March 26th issue. Despite the various examples which your article cited, the surface of this problem has barely been scratched. Apparently, the habits acquired by the aircraft industry in its early days when they could get all the engineers they wanted still persist. The habit of using graduate engineers to perform all tasks in an engineering department is only slowly being broken.

Suggests Criteria

In reviewing the trend towards better utilization in the aircraft industry we need to be reminded that talk is cheap. I would like to suggest three criteria to distinguish between those companies who are sufficiently concerned about utilization to really do something about it and those other companies who are only sufficiently concerned to talk about it.

1. Does the company advertise as widely for draftsmen and engineering aides as it does for engineers? Does it advertise for persons who completed one year of engineering and then dropped out of college?
2. Does the company provide really adequate paths of advancement for the good sub-professional employes? A salary future must be adequate to induce draftsmen and aides to make their career in that line of work. Otherwise, there will never be a supply of such people skilled enough to relieve engineers of their non-creative tasks.
3. Does the company provide facilities which are conducive to creative engineering? No company which provides auditorium-size drafting rooms for its engineers, with their attendant noise and confusion, is sufficiently worried about utilization to really do something about it.

The most serious aspect of poor utilization is one which is often over-looked. An engineer who has devoted the majority of his first five years, say, to performing tasks which he could have performed after graduation from high school is very much less capable than he could have been with five years of professional experience. Not only has he failed to grow at the rate of which he was capable, but he has also forgotten much of his college education.

Aside from the limited problem of poor utilization, there is no real career future for the employed professional engineer today. By providing special status and special privileges for their supervisors, most companies have made supervision the goal of most engineers. This practice has had the following results:

1. The engineer who prefers to practice engineering for his whole career is viewed by many as being an inferior engineer who could not make the grade into supervision.
2. Those engineers who do transfer into supervision are loaded down with administrative details and do progressively less real engineering work as time goes on.
3. When an engineering department grows very fast—as is typical in the aircraft industry—the majority of the good engineers are siphoned off into supervision as fast as they develop.

Supervisor Pay

In addition to the disadvantages which accrue to the company, the tragedy is that, in relation to responsibility, supervisors are usually the poorest paid engineers.

So long as less than 3% of the practicing engineers—less than 15% even when engineering supervisors are included—make less than twice the salary of the new graduate engineer, how can we argue that a professional career really exists? How can you persuade high school students to prepare for a professional career when one does not exist? There is no shortage of talk, but real effective action to alleviate the fundamental problems is as rare as hen's teeth.

DAN N. HENDRICKS, JR.
President
Seattle Professional Engineering Employees Assn.
3106 Arcade Building
Seattle 1, Washington

'Good Information'

Your two articles on the engineering shortage gives excellent coverage to an important and current problem. They contain good information on the opinions of people involved in any way in the solution to the problem and I find many helpful suggestions which I shall certainly examine for possible adoption.

R. L. BORTNER
Assistant Chief Engineer, Administration
Republic Aviation Corp.
Farmingdale, L. I., New York

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